APOLLO G&N Specification
ND1002325 REV - AA
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POST INSTALLATION CHECKOUT PROCESS SPECIFICATION FOR THE APOLLO GUIDANCE AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
5/9/69	U	37563	90, 93, 128-131	EA	RJJ
10/1/69	V	37863	25, 26	EA	MDH
10/15/69	W	37886	74-167; was 167 pages, now 168 pages.	EA	MDH
11/3/69	Y	37911	11, 12, 74-105, 107; was 168 pages, now 172 pages JFD/AC	EA	MDH
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4/2/70	AA	38088	92, 171, 172	EA	MDH

APPROVALS	Not required per CCA-497-0274 NASA/MSC	MIT/IL	R. D. Petryk D.A. Ziemer AC

6.2.14 Stabilitzation Loop Step Response Test

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.

6.2.14.4 Inner Gimbal Response Test

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.

6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 On CRT, verify IG Servo Error In Phase (CG 2117), MG Servo Error In Phase (CG 2147), and OG Servo Error In Phase (CG 2177) to be 0.0 ±60 mv RMS at null.

6.2.14.4.7 Enter 1000 into R155, Verify and execute to enter a DC step into the IG stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ±5 percent of the original step amplitude, In addition, record the total number of overshoots.

Change 8: Add the following step after Paragraph 6.2.2.8.4:

6.2.2.8.4.1 Enter the following into the K-START:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify R1 = 00004 or R1 = 00104.

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 9: Add the following step after Paragraph 6.2.2.9.1:

6.2.2.9.1.1 Enter the following into the K-START:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify R1 = 00020 or R1 = 00120.

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 10: Revise Paragraph 6.2.19.11 to read as follows:

6.2.19.11 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON. On K-148, enter the following:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible, but bit 6 must be on.

Change 11: Add Paragraph 6.2.19.11.1 as follows:

6.2.19.11.1 On K-148, enter the following sequence:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR
Press RSET
VERB 21 NOUN 27 ENTR
77777 ENTR

Change 12: Revise Paragraph 6.2.19.18 to read as follows:

6.2.19.18 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON. On K-148, enter the following:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify DSKY Row 1 display has bit 6 ON. Other combinations of bits are permissible, but bit 6 must be on.

Change 13: Add Paragraph 6.2.19.18.1 as follows:

6.2.19.18.1 On K-148, enter the following sequence:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
Press           RSET
VERB 21 NOUN 27 ENTR
77777           ENTR
```

Change 14: Revise Paragraph 6.2.19.25 to read as follows:

6.2.19.25 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON. On K-148, enter the following:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible, but bit 6 must be on.

Change 15: Add Paragraph 6.2.19.25.1 as follows:

6.2.19.25.1 On K-148, enter the following sequence:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
Press           RSET
VERB 21 NOUN 27 ENTR
77777           ENTR
```

Change 16: Revise Paragraph 6.2.19.33 to read as follows:

6.2.19.33 On K-148, enter the following:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible, but bit 6 must be on.

Change 17: Add Paragraph 6.2.19.33.1 as follows:

6.2.19.33.1 Terminate CMC Self Check by entering the following sequence on K-148:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
Press           RSET
VERB 21 NOUN 27 ENTR
00000           ENTR
```

Change 18: Add the following step after Paragraph 6.2.2.10.10.

6.2.2.10.10.1 Enter the following on K-148 if the RESTART lamp lights in the previous step.

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

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				MIT	NASA
5/25/70	AB	38167	15-38, 42, 50-56, 59-61, 64, 67,	EA	MDH
			71, 85, 91, 92, 105, 113, 121, 122,		
			126, 130-172; was 172 pages,		
			now 169 pages.		

This specification consists of page 1 to 169 including Appendix I, pages 144-145, Addendum I, pages 146-167, Addendum II, page 168 and Addendum III, page 169.

APPROVALS	Not required per CCA-497-0274 **NASA/MSC**		**MIT/IL**		R.D. Petryk	D.A. Ziemer
					ACSP	

Record the value of R1.

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

NOTE: If the INLINK MONITOR program as found on K-START Tape NO5C112-K10554-XX, CSM S/C TEST TAPE N/R SITE is loaded, Channel 77 can be monitored and recorded on the CRT.

5.13.5.1 The contents of R1 should be interpreted as follows:

Channel 77 Code (Octal)	Alarm Source
001	*[1] *[2] Parity Fail (F Memory)
003	*[1] *[2] Parity Fail (E Memory)
004	*[2] TC Trap
010	*[2] Rupt Lock
020	*[2] Nightwatchman
040	*[3] Voltage Fail
100	Counter Fail
200	Scaler Fail
400	Scaler Double Frequency Alarm

*[1] NOTE: Parity Fail will occur either in E or F Memory, but not in combination.

*[2] NOTE: Depending on when the various alarms occur, a Counter Fail Alarm may also occur, and Bit 7 will therefore be set also.

*[3] NOTE: Other alarms will probably occur before the Voltage Fail Alarm occur, in which case the contents of Channel 77 will contain the octal sum of all the alarms but it will contain the Voltage Fail Code.

6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. 513-100. The temperature of the IRIG's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period, but not less than 15 minutes, shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

TABLE III. RESISTANCE REQUIREMENTS FOR G&N
POWER CONNECTORS

Test No.	From	To	Requirements (ohms)	Results
1	J1-15	J1-6	1000 to infinity	
2	J1-15	J1-14	1000 to infinity	
3	J1-15	J1-1	1000 to infinity	
4	J1-15	J1-18	5 meg to infinity	
5	J1-15	J1-16	0.0 to 0.5	
6	J1-15	J1-3	0.0 to 0.5	
7	J1-15	J2-15	0.0 to 0.5	
8	J1-14	J2-14	0.0 to 0.5	
9	J1-1	J2-1	0.0 to 0.5	
10	J1-6	J2-6	0.0 to 0.5	
11	J1-16	J2-16	0.0 to 0.5	
12	J1-3	J2-3	0.0 to 0.5	
13	J1-14	J1-6	1000 to infinity	
14	J1-1	J1-14	1000 to infinity	
15	J1-1	J1-6	0.0 to 2.0	
16	J1-18	J1-6	5 meg to infinity	
17	J1-18	J1-14	5 meg to infinity	
18	J1-18	J1-1	5 meg to infinity	
19	J1-2	J1-1	2.8 to infinity	
20	J1-9	J1-15	1.1 to infinity	
21	J1-10	J1-16	1.1 to infinity	
22	J1-7	J1-14	2.8 to infinity	
23	J1-8	J1-3	3.7 to infinity	
24	J1-17	J1-18	5 to 20	
25	J2-2	J2-1	2.8 to infinity	
26	J2-9	J2-15	1.1 to infinity	
27	J2-10	J2-16	1.1 to infinity	
28	J2-7	J2-14	2.8 to infinity	
29	J2-8	J2-3	3.7 to infinity	

6.1.3.5 Disconnect the test cable connectors J1 and J2 from G&N power connectors 56P30 and 56P31, respectively. Mate G&N connector 56P30 to S/C connector CO3W1J345 and mate G&N connector 56P31 to S/C connector CO3W1J346. Mate G&N connector 56P32 to S/C connector CO3W1J347.

6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.

6.2.1.2 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.

6.2.1.3 The Inertial Component Temperature Controller (ICTC) shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.

6.2.1.4 Computer Power On

6.2.1.4.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).

NOTE: Restart Lamp may illuminate, if it does, disregard and press RSET on the DSKY.

6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.

6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.

6.2.1.4.3.1 Enter the following into K-148:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

6.2.1.4.4 The +28 VDC CMC OPERATE voltage (CG 1520) shall be +28.0±3 VDC. Verify CRT indication. On the G&N Indicator Control Panel verify PGNS light is ON.

6.2.1.4.4.1 Enter the following into K-148:

```
VERB 21 NOUN 01 ENTR
03700           ENTR
33663           ENTR
NOUN 15         ENTR
55426           ENTR ENTR
04064           ENTR ENTR
15374           ENTR
VERB 25 NOUN 26 ENTR
20000           ENTR
01700           ENTR
12007           ENTR
VERB 30         ENTR
```

On the DSKY verify TEMP light is ON.

6.2.2.5.8 Set the UP TLM switch on the MAIN DISPLAY Panel to BLOCK. Verify that the BLOCK UPLINK discrete is ON. [illegible]

6.2.2.5.9 On K-148 insert VERB. Verify VERB indication on the DSKY and CRT does not change.

6.2.2.5.10 Set the UP TLM switch on the MAIN DISPLAY Panel to ACCEPT. Verify that the BLOCK UPLINK discrete is OFF. Remove the Block Uplink Override R-START.

6.2.2.5.11 On K-148 insert VERB 36. Press the ENTER pushbutton.

6.2.2.5.12 Verify K-START Tape N05C112-K10554-XX, CSM S/C TEST TAPE N/R SITE is on the K-START Tape Reader.

6.2.2.5.12.1 Start Tape Reader.

6.2.2.5.12.2 When the Tape Reader stops, verify:

R1 = +05003
R2 = +10554
R3 = -000XX (XX tape revision number)

6.2.2.5.12.3 Start the Tape Reader.

6.2.2.5.12.4 When the Tape Reader stops, verify the following:

(a) R1 = 00101

(b) On CRT, the two most significant octal digits of CH77 are incrementing.

6.2.2.8.2 When the Tape Reader stops, verify the following:

(a) RESTART lamp on the DSKY is lit.
(b) The PGNCS Caution lamp is lit.
(c) V05 N31 displayed on DSKY.
(d) On CRT, CH77 low three (3) octal digits are 004 or 104.
(e) On CRT, CH77 two (2) most significant octal digits are incrementing.

6.2.2.8.3 Press the RSET pushbutton on the K-START. The RESTART and PGNCS Caution lamps shall extinguish.

6.2.2.8.4 Start Tape Reader.

6.2.2.8.5 When the Tape Reader stops, verify the following:

(a) RESTART lamp on the DSKY is lit.
(b) The PGNCS Caution lamp is lit.
(c) V05 N31 displayed on DSKY.
(d) On CRT, CH77 low three (3) octal digits are 004 or 104.
(e) On CRT, CH77 two (2) most significant octal digits are incrementing.

6.2.2.8.6 Press the RSET pushbutton on the K-START. The RESTART and PGNCS Caution lamps shall extinguish.

6.2.2.9 Nightwatchman Test

6.2.2.9.1 Start Tape Reader.

6.2.2.9.2 When the Tape Reader stops, verify the following:

(a) RESTART lamp on the DSKY is lit.
(b) The PGNCS Caution lamp is lit.
(c) V05 N31 displayed on DSKY.
(d) On CRT, CH77 low three (3) octal digits are 020 or 120.
(e) On CRT, CH77 two (2) most significant octal digits are incrementing.

6.2.2.9.3 Press RSET pushbutton on the K-START. The RESTART and PGNCS Caution lamps shall extinguish.

6.2.2.10 CMC Clock Frequency Test

6.2.2.10.1 Insure that the CMC is in the Standby Mode by verifying that the STBY pushbutton on the DSKY's is lit. If it is not lit enter VERB 60, ENTER into the DSKY. Push and hold the STBY pushbutton until it lights. Verify that the NO ATT and TEMP lamps on the DSKY's light.

6.2.2.10.2 Insure that the IMU 3.2 kc 28V Supply is available on the vertical input to PIPA Scope.

6.2.2.10.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.

6.2.2.10.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.

6.2.2.10.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.

6.2.2.10.5 Set the preset counter to indicate 96000.

6.2.2.10.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).

6.2.2.10.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.

6.2.2.10.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.

6.2.2.10.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result. The average of the 10 previous readings shall be 30.000000±0.000060 seconds.

6.2.2.10.10 Remove the CMC from Standby Mode by performing the following DSKY operations.

a. Press and hold the STBY pushbutton until it extinguishes.
b. Press the RESET pushbutton.
c. VERB 61, ENTER
d. VERB 36, ENTER.

NOTE: Restart Lamp may illuminate; if it does, disregard and press RSET on the DSKY.

6.2.2.10.10.1 Enter the following into K-148:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

6.2.2.11 Mark and Mark Reject pushbutton test.

6.2.2.11.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right-Hand Circuit Breaker Panel (breakers pushed in), and placing G/N POWER -OPTICS switch on the LEB Lighting Control Panel to ON.

NOTE: The MARK REJECT portion of this test can be run without turning on the OPTICS power.

6.2.2.11.1.1 On the G&N Indicator Control Panel, press and hold MARK pushbutton.

6.2.2.11.2 Enter the following on K-148.

VERB 11 NOUN 10 ENTR
00016 ENTR

6.2.2.11.3 Observe the DSKY Row 1 displays 0004X.

6.2.2.11.4 Release MARK pushbutton

6.2.2.11.5 Observe that DSKY Row 1 displays 0000X.

6.2.2.11.6 Press and hold the REJECT pushbutton on the G&N Indicator Control Panel.

6.2.2.11.7 On the DSKY, observe:

VERB 05 NOUN 31
R1 displays 00112
PROG Alarm lamp is lit.

On the G&N Caution and Warning Panel, the PGNS Caution lamp is lit.

6.2.2.11.8 Enter the following into K-148:

VERB 11 NOUN 10 ENTR
00016 ENTR
Press ERR RSET

Verify PROG Alarm and PGNS Caution lamps extinguish and DSKY Row 1 displays 0010X.

6.2.2.11.9 Release the REJECT pushbutton.

6.2.2.11.10 Observe that DSKY Row 1 displays 0000X.

6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.

a. CMC Warning
b. ISS Warning
c. PGNS Caution

6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.3.1.9 Verify K-START tape N05C112-K10554-XX CSM S/C TEST TAPE is on the K-START tape reader at Section 00203.

6.2.3.1.9.1 Start Tape Reader.

6.2.3.1.10 When the Tape Reader stops, verify the following:

(a) R1 = 00203
(b) CMC Activity light ON.
(c) On CRT, the two most significant octal digits of CH77 incrementing.
(d) The NO ATT light is ON.

6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

Table VI. Secondary Power Supply Voltages

	Meas. No.	Signal
1	CG 1040	+120 VDC PIPA SUPPLY
2	CG 1051	+20 VDC PIPA SUPPLY
3	CG 1052	-20 VDC PIPA SUPPLY
4	CG 1070	+4 VDC CDU SUPPLY
5	CG 1100	-28 VDC ELECTRONICS
6	CG 1020	+14 VDC CMC SUPPLY
7	CG 1030	+4 VDC CMC SUPPLY
8	CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9	CG 1202	IMU 28V 800 CPS 5 pct ph A
10	CG 1203	IMU 28V 800 CPS 5 pct ph B
11	CG 1331	3.2KC 28V SUPPLY
12	CG 1110	2.5 VDC TM BIAS

6.2.3.1.12 Monitor the PIPA temperature during the first 15 minutes after switching from Standby Mode to the Operate Mode. The PIPA temperature shall be 130.5±2.0 deg. F. during this period. 15 minutes after switching from Standby Mode to the Operate Mode, record the PIPA temperature. The recorded PIPA temperature shall be within 0.5 deg. F. of the Operate stabilized PIPA temperature determined below.

6.2.3.1.13 Deleted

6.2.3.1.14 30 minutes after entering the IMU Operate Mode, start recording PIPA TEMP every 5 minutes until the PIPA temperature is stabilized. The PIPA temperature shall be considered stabilized when the temperature change is not more than 0.1 deg for 30 minutes. Record the PIPA Operate Mode stabilized temperature. The PIPA Operate Mode stabilized temperature shall be 130.5±1.5 deg. F. and within 1.0 deg. F. of stabilized PIPA temperature.

6.2.3.1.15 Deleted

6.2.5.2.3 Energize the G&N COMPUTER MN A and MN B breakers on the right hand circuit breaker panel (breakers pushed in). Enter VERB 61 into K-148 and press the ENTER pushbutton. Verify +14 and +4 VDC CMC power supply outputs on CRT display. Voltages shall be +14.0±0.4 VDC (CG1020) and +4.0±0.2 VDC (CG1030).

NOTE: RESTART lamp may illuminate; if it does, disregard and press RSET on the DSKY.

On DSKY verify TEMP light is ON. On the G&N Indicator Control Panel verify PGNS light is ON.

6.2.5.2.4 Energize the G&N IMU HTR MN A and MN B breakers on the right hand circuit breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify TEMP light on DSKY is extinguished. Verify PGNS light on the G&N Indicator Control Panel is extinguished.

6.2.5.2.4.1 Set/verify the following switches on the PSAAM:

a. PSAAM POWER to ON.
b. INHIBIT VOLTAGE FAIL to OFF.

6.2.5.2.5 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS-NUMERICS control on both left hand circuit breaker panel and LEB Light Control Panel.

6.2.5.2.6 Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton on K148. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared. Verify PROG = 00.

6.2.5.2.7 Enter the following into K-148:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K148:

a. VERB 21, NOUN 27, ENTER
b. 77777, ENTER
c. VERB 15, NOUN 01; ENTER
d. 01366, ENTER

6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed.

a. VERB 05, NOUN 31
b. R1 = 01102
c. R2 = XXXXX c (SFAIL)
d. R3 = XXXXX c (ERCOUNT)

6.2.5.2.8.2 Terminate the monitor routine by entering the following into the DSKY

VERB 34, ENTER

6.2.5.2.8.3 Terminate Self-Test by entering the following into the K-Start:

a. VERB 21, NOUN 27, ENTER
b. 00000, ENTER

6.2.5.2.8.4 Verify Tape Reader is loaded with tape N05C112-K10554-XX to Section 00201. Start the Tape Reader.

6.2.5.2.8.4.1 When the Tape Reader stops, verify:

a. R1 = 00201
b. On CRT, CH77 two most significant octal digits incrementing.

6.2.5.2.8.5 Start Tape Reader.

6.2.5.2.8.5.1 When the Tape Reader stops, verify:

a. R1 = 00202
b. The CMC Activity light is ON.

NOTE: If a VERB 36 is performed after the tape is loaded, enter the following on the DSKY to recall the CMC Activity light ON:

```
VERB 25 NOUN 26 ENTR
01000           ENTR
01770           ENTR
00007           ENTR
VERB 30         ENTR
```

An exception is the VERB 36 performed when entering Voltage Margin Test (6.2.19). After completing Voltage Margin Test, enter the above sequence.

NOTE: Allow two (2) hours to elapse before proceeding to Step 6.2.5.2.9, with the following exceptions:

a. If the G&N System has been in power off state for less than 5 days with the gimbals in the following positions:

   X = 000.00±005.00 deg
   Y = 000.00±005.00 deg
   Z = 090.00±005.00 deg

   or has been in power off state for less than 12 days with gimbals in the following positions:

   X = 000.00±001.00 deg
   Y = 000.00±001.00 deg
   Z = 090.00±001.00 deg

   and the system has not been moved, then allow only 15 minutes to elapse before proceeding.

b. If the G&N System has been turned off with the gimbals in the unparked position for less than two (2) hours, allow a warmup time equal to the time off, but not less than 15 minutes to lapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU operate power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.3.2.1 If K-START Tape N05C112-K10554-XX is loaded on the tape reader, proceed to Step 6.2.5.3.5.2.

6.2.5.3.3 Enter VERB 36, ENTER into K148.

6.2.5.3.4 Enter VERB 40 NOUN 20, ENTER into K148.

6.2.5.3.5 Enter the following into K148:

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal angles are 0±1.5° as indicated by the CDUX, CDUY, and CDUZ displays on the CRT.

6.2.5.3.5.1 Proceed to Step 6.2.5.3.6.

6.2.5.3.5.2 Verify K-START Tape is at Section 00203 or 00400. Start Tape Reader.

6.2.5.3.5.3 When the Tape Reader stops, verify the following:

a; R1 = 00203 or 00400.

b. CMC Activity light ON.

c. On CRT, the two most significant octal digits of CH77 incrementing.

d. The NO ATT light is ON, and the Inner, Outer and Middle Gimbal Angles are 0±1.5 deg as indicated by the CDUX, CDUY and CDUZ displays on the CRT.

6.2.5.3.6 Insure that the following switches are set to the positions indicated.

a. OPTICS COUPLING to DIRECT
b. OPTICS ZERO to OFF
c. OPTICS MODE to MAN
d. OPTICS TEL TRUN to SLAVE to SXT
e. OPTICS SPEED to LO
f. CONDITION LAMPS to ON
g. UP TELEMETRY to ACCEPT

6.2.5.3.7 Deleted.

6.2.6 G&N Operational Test

6.2.6.1 Initial Conditions

Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn on Procedure of 6.2.5 has been completed and system operation has not be interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.6.2.2 On K-148 enter the following sequence:

VERB 57	ENTR
00004	ENTR

6.2.6.2.3 Observe VERB 16 NOUN 20 displayed on CRT. The NO ATT discrete shall appear momentarily then go OFF. Verify that the PROGRAM displayed on the CRT indicates 07.
Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be 980.00000±05.00000 cm/sec^2.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always be 00000. The horizontal earth rate shall be 00000.83000±0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Verify K-START Tape N05C112-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00203.

6.2.6.3.2 Start the Tape Reader.

6.2.6.3.3 When the Tape Reader stops, verify the following:

(a) R1 = 00203
(b) CMC Activity light ON.
(c) On CRT, the two most significant octal digits of CH77 incrementing.
(d) The NO ATT light is ON.

6.2.7.4.8 Enter the following sequence in the K-Start:

a. VERB 42, press ENTR
b. VERB 33, press ENTR

6.2.7.4.9 Start analog recorders.

6.2.7.4.10 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs (approximately 5 minutes), stop the recorders.

6.2.7.4.11 Verify K-START Tape N05C112-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00203.

6.2.7.4.12 Start the Tape Reader.

6.2.7.4.13 When the Tape Reader stops, verify the following:

(a) R1 = 00203

(b) CMC Activity light ON.

(c) On CRT, the two most significant octal digits of CH77 incrementing.

(d) The NO ATT light is ON.

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque Motor current traces and disregard all transients on the CDU Fine Error and CDU Coarse Error traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ±70 mv rms. The CDU Coarse Error measurement shall not exceed ±680 mv rms.

6.2.9.1.1.2 Proceed to 6.2.9.1.3 after manual entry of above data.

6.2.9.1.2 Tape loaded input.

6.2.9.1.2.1 Verify Tape N05C112-K10554-XX is on the Tape Reader and at Section 00300.

6.2.9.1.2.2 Start the Tape Reader.

6.2.9.1.2.3 When the Tape Reader stops, verify:

R1 = 00300

6.2.9.1.3 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% 0ph (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.9.1.4 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.9.1.5 Enter 00010 into K148. Press the ENTER pushbutton.

6.2.9.1.6 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.

6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 02 flashing
b. R1 = +00000±00007
c. R2 = +00000±00007
d. R3 = +00000±00007
e. IG angle = 000±1 deg.
f. MG angle = 000±1 deg.
g. OG angle = 000±1 deg.

6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 03 flashing
b. R1 = +04500±00007
c. R2 = +04500±00007
d. R3 = +04500±00007
e. IG angle = 045±1 deg.
f. MG angle = 045±1 deg.
g. OG angle = 045±1 deg.

6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing
b. R1 = 00000±00003

6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.

6.2.13 Optics Slew Rate Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.13.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.13.2 Deleted.

6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.

a. TEL TRUN to SLAVE to SXT
b. OPTICS COUPLING to DIRECT
c. OPTICS SPEED to HI
d. OPTICS MODE to MAN

6.2.13.4 Monitor MARK COMMAND by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.

TRUNNION SLEW RATE - HI SPEED

6.2.13.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF.

NOTE: Read and understand Step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.

6.2.13.6 While slewing the optics, record the following signals: SXT TRUN SERVO error (CG 3118), SXT TRUN TACH (CG 3150), and SCT TRUN TACH (CG 3170). CG 3118 shall be between -0.25 and -2.0 VRMS. CG 3150 shall be 3.3±1.3 VRMS. CG 3170 shall be -0.85±0.35 VRMS.

OPTICS HAND CONTROLLER DRIFT RATE CHECK - LO SPEED

6.2.13.23 On K-148, enter VERB 06 NOUN 56 ENTER. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF.

6.2.13.24 Press and release MARK pushbutton. Approximately 60 seconds after the first MARK, again press and release MARK pushbutton. Verify KEY RELEASE is flashing. Press KEY RELEASE pushbutton and record data in R1, R2 and R3 within 2 seconds. When DSKY display changes, again record R1, R2 and R3. The data display is in the following form:

a. R1 = ±XXX.XX (Shaft Angle in Degrees)
b. R2 = ±XX.XXX (Trunnion Angle in Degrees)
c. R3 = +XXX.XX (Time in Seconds)

6.2.13.25 Perform the following calculations (first display minus second display):

a. Difference between R1 displays = ______ (Δ shaft angle)
b. Difference between R2 displays = ______ (Δ trunnion angles)
c. Difference between R3 displays = ______ (Δ time)
d. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} =$ ______ deg/sec (shaft drift rate)
shall be less than 0.0333 deg/sec.
e. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} =$ ______ deg/sec (trunnion drift rate)
shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.14 Stabilization Loop Step Response Test

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.3 Verify K-START Tape N05C112-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00400.

6.2.14.3.1 Start the Tape Reader.

6.2.14.3.2 When the tape reader stops, press ERR RSET pushbutton and verify the following:

(a) R1 = 00400

b. CMC Activity light ON.
c. On CRT the two most significant octal digits of CH77 incrementing.
d. The NO ATT light is ON.

6.2.14.4 Inner Gimbal Response Test

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Deleted.

6.2.14.4.3 Deleted.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 On CRT, verify IG Servo Error In Phase (CG 2117), MG Servo Error In Phase (CG 2147), and OG Servo Error In Phase (CG 2177) to be 0.0± 60 mv RMS at null.

6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ±5 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.16.7.59 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.60 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 [.707 (NBDY-NBDX) + .5 (ADIAY-ADIAX) + .5 ADSRA X] Position +00010.

6.2.16.7.61 Test Termination

6.2.16.7.62 Verify K-START Tape N05C112-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00400.

6.2.16.7.63 Start the Tape Reader.

6.2.16.7.64 When the Tape Reader stops, verify the following:

(a) R1 = 00400.
(b) CMC Activity light ON.
(c) On CRT, the two most significant octal digits of CH77 incrementing.
(d) The NO ATT light ON.

6.2.16.9 Deleted.

6.2.17 SXT-NB-IMU Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification Fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Optical Reference No. 1) shall be known to ±30 minutes of arc.

NOTE: The G&N shall have had OPERATE power applied for a minimum of 1 hour. Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG1211) and OPTIX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.17.3 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA.

If the recorded value is within any of the sets of limits given in Table 1 proceed with the test. If the recorded value is NOT within any of the sets of limits, wait 30 minutes and then repeat this step or enter VERB 11 NOUN 10 ENTER, 00003 ENTER and proceed when the monitored value is within the limits set in Table I.

TABLE I

MIN VALUE		MAX VALUE
00000	AAAAA	03100
04000	AAAAA	07100
10000	AAAAA	13100
14000	AAAAA	17100
20000	AAAAA	23100
24000	AAAAA	27100
30000	AAAAA	33100
34000	AAAAA	37100

6.2.17.4 Deleted.

6.2.17.5 On the G&N Indicator Control Panel set the following switches to the position indicated.

a. OPTICS TEL TRUN to SLAVE to SXT
b. OPTICS COUPLING to DIRECT
c. OPTICS SPEED to LO
d. OPTICS MODE to MAN

6.2.17.5.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC. Set OPTICS ZERO to ZERO.

6.2.17.60 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc-seconds (R1 = whole, R2 = fractional). (See Table II for PIPA displayed). Record R1 and R2.

6.2.17.61 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.

6.2.17.62 Repeat Steps 6.2.17.33 through 6.2.17.61, substituting numbers as follows:

00000 in Step 6.2.17.35.c
00001 in Step 6.2.17.35.e

+00000 in Step 6.2.17.44.b
+89999 in Step 6.2.17.44.c

6.2.17.63 Verify K-START Tape N05C112-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00400.

6.2.17.63.1 Start the Tape Reader.

6.2.17.63.2 When the tape reader stops, verify the following:

(a) R1 = 00400.
(b) CMC Activity light ON
(c) On CRT, the two most significant octal digits of CH77 incrementing.
(d) The NO ATT light ON

TABLE II

Display Conditions at Test Completion

Position	SM Orientation			Horizontal Misalignment Component	
	X_{XM}	Y_{SM}	Z_{SM}	6.2.17.29 & .59	6.2.17.30 & .60
1	UP	SW	SE	Y_{SM}	Z_{SM}
2	SE	SW	DN	X_{SM}	Y_{SM}
4	DN	SE	SW	Y_{SM}	Z_{SM}
5	SW	SE	UP	X_{SM}	Y_{SM}

6.2.17.64 Set the G/N POWER-OPTICS switch on the LEM Lighting Control Panel to OFF.

6.2.17.65 Calculations

6.2.17.65.1
a. Y_{SM} misalignment = ( ) $\underline{\text{R1}\cdot\text{R2}}$
b. Z_{SM} misalignment = ( ) $\underline{\text{R1}\cdot\text{R2}}$

6.2.17.65.1 (Continued)

c. X_{SM} misalignment = ( ) $\underline{R1 \cdot R2}$
d. Y_{SM} misalignment = ( ) $\underline{R1 \cdot R2}$
e. Y_{SM} misalignment = ( ) $\underline{R1 \cdot R2}$
f. Z_{SM} misalignment = ( ) $\underline{R1 \cdot R2}$
g. X_{SM} misalignment = ( ) $\underline{R1 \cdot R2}$
h. Y_{SM} misalignment = ( ) $\underline{R1 \cdot R2}$

6.2.17.65.2 Enter the latest values from 6.2.16 IMU Performance Test

a. X PIPA bias = ______________ cm/sec^2
b. Y PIPA bias = ______________ cm/sec^2
c. Z PIPA bias = ______________ cm/sec^2
d. θ_X = 210 (X PIPA bias) = __________________ arc-sec.
e. θ_Y = 210 (Y PIPA bias) = __________________ arc-sec.
f. θ_Z = 210 (Z PIPA bias) = __________________ arc-sec.

6.2.17.65.3 a. Z_{SM} misalignment (bias corrected) =

6.2.17.65.1.b - θ_Z = ______________ arc-sec.

b. X_{SM} misalignment (bias corrected) =

6.2.17.65.1.c - θ_X = ______________ arc-sec.

c. Y_{SM} misalignment (bias corrected) =

6.2.17.65.1.e - θ_Y = ______________ arc-sec.

d. Y_{SM} misalignment (bias corrected) =

6.2.17.65.1.h - θ_Y = ______________ arc-sec.

The SM misalignments in each orientation, excluding PIPA bias, shall not exceed ±150 arc-seconds.

6.2.18 Gyrocompassing Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.18.1 Set the G/N POWER-OPTICS Switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90°h (CG 1212) are not flashing on the CRT.

6.2.18.17 After the correct readings for R1 and R2 are verified enter VERB 33 into the K-Start. Press the ENTER pushbutton.

6.2.18.18 Using the Optics Hand Controller, align the SXT StLOS to target 1 and press the MARK pushbutton. If satisfied that the MARK was good, proceed. If not satisfied with MARK, press the MARK REJECT pushbutton and repeat the step.

6.2.18.19 Set the OPTICS SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target No. 2.

6.2.18.20 Set the OPTICS SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisified, press the MARK REJECT pushbutton and repeat this step.

6.2.18.21 On the CRT observe the following data displayed:

a. VERB 06 NOUN 60
b. R1 = ±xx.xxx (X gyro elevation error, degrees)
c. R2 = ±xx.xxx (Y gyro elevation error, degrees)
d. R3 = ±xx.xxx (Z gyro azimuth error, degrees)

Record R1, R2 and R3.

6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO.

6.2.18.23 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.18.24 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start three times. Press the ENTER pushbutton after each entry. Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

6.2.18.23 Verify K-START Tape N05C112-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00400.

6.2.18.24 Start Tape Reader.

6.2.18.24.1 When the Tape Reader stops, verify the following:

(a) R1 = 00400.
(b) CMC Activity light ON.
(c) On CRT, the two most significant octal digits of CH77 incrementing.
(d) The NO ATT light ON.

Set the G/N POWER OPTICS Switch on the LEB Lighting Control Panel to OFF.

6.2.19.11 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON. On K-148, enter the following:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible, but bit 6 must be on.

6.2.19.11.1 On K-148, enter the following sequence:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
Press           RSET
VERB 21 NOUN 27 ENTR
77777           ENTR
```

6.2.19.12 Units R-154, insert 0001. Verify and execute.

6.2.19.13 Insert in C-156 +084001244 and execute. Verify on CRT that GV0116 is between +7.4 and 9.4 vdc.

6.2.19.14 Units R-154, insert 0111. Verify and execute.

6.2.19.15 Observe CG 1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C Start entry until CG 1020 is 16.4, +0.1, -0.0 vdc.

6.2.19.16 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that;

a. VERB 05, NOUN 31
b. R1 = 01102
does not appear on DSKY.

6.2.19.16.1 Into R-154, insert 0011. Verify and execute.

6.2.19.17 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.

6.2.19.18 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON. On K-148, enter the following:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify DSKY Row 1 display has bit 6 ON. Other combinations of bits are permissible, but bit 6 must be on.

6.2.19.18.1 On K-148, enter the following sequence:

VERB 21 NOUN 10	ENTR
00077	ENTR
00000	ENTR
Press	RSET
VERB 21 NOUN 27	ENTR
77777	ENTR

6.2.19.19 Units R-154, insert 0001. Verify and execute.

6.2.19.20 Insert in C-156, +082001234 and execute. Verify on CRT that GV0106 is between +7.2 and +9.2 vdc.

6.2.19.21 Units R-154, insert 0111. Verify and execute.

6.2.19.22 Observe CG 1030, +4 VDC Power Supply on CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C Start entry until CG 1030 is 4.60, +0.03, -0.00 vdc.

6.2.19.23 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:

a. VERB 05, NOUN 31
b. R1=01102 does not appear on DSKY.

6.2.19.23.1 Into R-154, insert 0101. Verify and execute.

6.2.19.24 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.

6.2.19.25 On PSAAM, set INHIBIT VOLTAGE FAIL switch ON. On K-148 enter the following:

VERB 01 NOUN 10	ENTR
00077	ENTR

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible, but bit 6 must be on.

6.2.19.25.1 On K-148, enter the following sequence:

VERB 21 NOUN 10	ENTR
00077	ENTR
00000	ENTR
Press	RSET
VERB 21 NOUN 27	ENTR
77777	ENTR

6.2.19.26 Units R-154, insert 0001. Verify and execute.

6.2.19.27 Insert in C-156, -010001244 and execute. Verify on CRT that GV0116 is between 0.0 and -2.0 vdc.

6.2.19.28 Units R-154, insert 0111. Verify and execute.

6.2.19.29 Observe CG1020, +14 VDC Power Supply on CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C Start entry until CG 1020 is 12.1, +0.1, -0.0 vdc.

6.2.19.30 Press ERROR RESET on K-148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that:

a. VERB 05, NOUN 31
b. R1 = 01102
does not appear on DSKY.

6.2.19.30.1 Into R-154, insert 0011. Verify and execute.

6.2.19.31 Set INHIBIT VOLTAGE FAIL switch to OFF, on PSAAM. Verify that DSKY RESTART lamp is lighted. Disregard other DSKY indications. Verify CMC Warning master alarms are lighted.

6.2.19.32 Units R-154, insert 0000. Verify and execute.

6.2.19.33 On K-148, enter the following:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify DSKY Row 1 display has bit 6 on. Other combinations of bits are permissible, but bit 6 must be on.

6.2.19.33.1 Terminate CMC Self-Check by entering the following sequence on K-148:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
Press           RSET
VERB 21 NOUN 27 ENTR
00000           ENTR
```

6.2.19.34 Ensure that CG 1020, +14 VDC Power Supply indication is +14.0, ±0.4, and that CG 1030, +4 VDC Power Supply indication is +4.00±0.20 VDC on CRT.

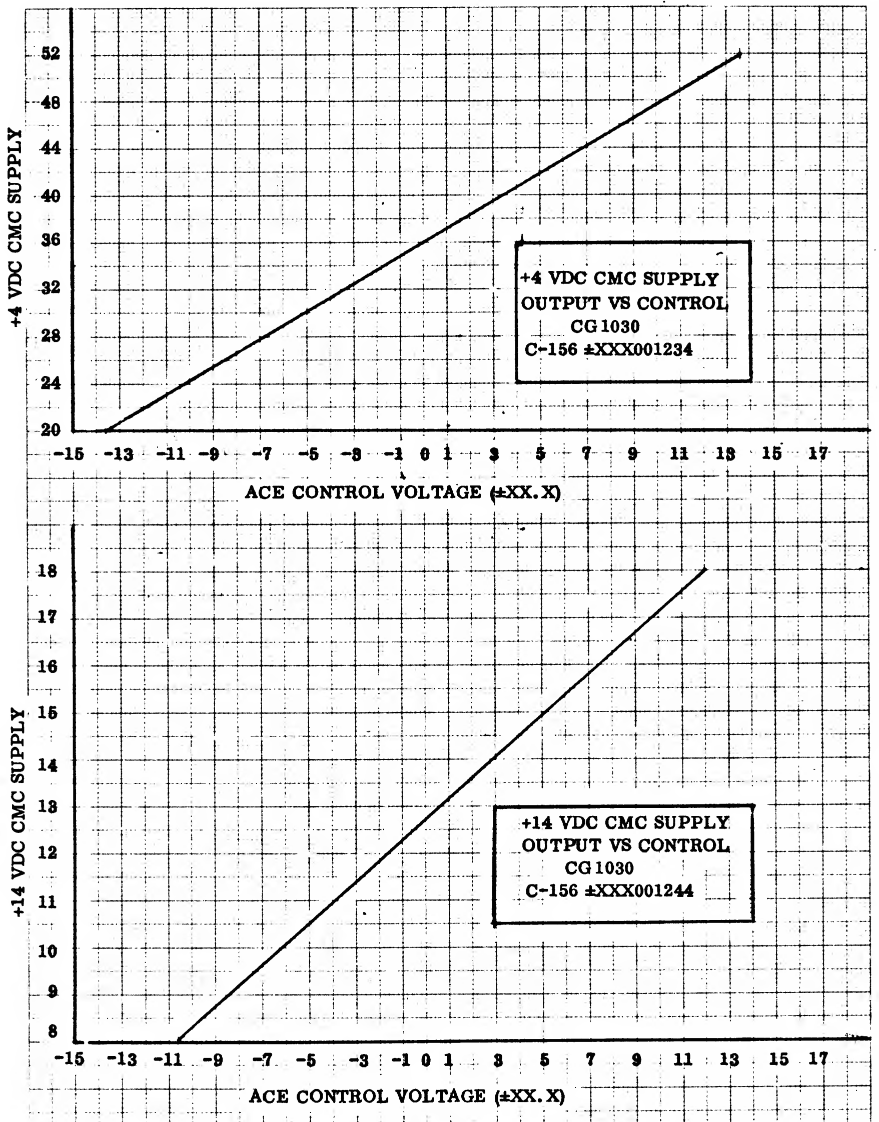
+4 VDC CMC SUPPLY
52
48
44
40
36
32
28
24
20
+4 VDC CMC SUPPLY OUTPUT VS CONTROL
CG 1030
C-156 ±XXX001234
-15 -13 -11 -9 -7 -5 -3 -1 0 1 3 5 7 9 11 13 15 17
ACE CONTROL VOLTAGE (±XX.X)
+14 VDC CMC SUPPLY
18
17
16
15
14
13
12
11
10
9
8
+14 VDC CMC SUPPLY OUTPUT VS CONTROL
CG 1030
C-156 ±XXX001244
-15 -13 -11 -9 -7 -5 -3 -1 0 1 3 5 7 9 11 13 15 17
ACE CONTROL VOLTAGE (±XX.X)

TABLE I

6.2.20 Spacecraft Control and Displays Test

6.2.20.1 Perform Master Initialization before proceeding.

6.2.20.2 FDAI Attitude Error

6.2.20.2.1 Insert in K148

a. V 57 ENTER
b. 00013 ENTER

6.2.20.2.2 Observe on CRT

a. V 06 N01 Flashing
b. PROG 07
c. NO ATT ON
d. R1, R2, and R3 Approx. 00000

6.2.20.2.3 Insert in K148

a. VERB 33, ENTER

6.2.20.2.4 Observe on CRT

a. V 06 N01 Flashing
b. R1 +00385
c. R2 -00385
d. R3 +00385
e. NO ATT OFF

6.2.20.2.5 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +5.06±0.66 VRMS
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -5.06±0.66 VRMS
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +5.06±0.66 VRMS

6.2.20.2.6 Insert in K148

a. VERB 33, ENTER

6.2.20.2.7 Observe on CRT

a. V 06 N01 Flashing
b. R1 +00384
c. R2 -00384
d. R3 +00384

6.2.20.2.8 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.06±0.66 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.06±0.66 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.06±0.66 VRMS

6.2.20.2.9 Insert in K148

a. VERB 33, ENTER

6.2.20.2.10 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00160
c.	R2		-00160
d.	R3		+00160

6.2.20.2.11 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+2.11±0.27 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-2.11±0.27 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+2.11±0.27 VRMS

6.2.20.2.12 Insert in K148

a. VERB 33, ENTER

6.2.20.2.13 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00135
c.	R2		-00135
d.	R3		+00135

6.2.20.2.14 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+1.78±0.23 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-1.78±0.23 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+1.78±0.23 VRMS

6.2.20.2.15 Insert in K148

a. VERB 33, ENTER

6.2.20.2.16 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00090

6.2.20.2.8 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.06±0.66 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.06±0.66 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.06±0.66 VRMS

6.2.20.2.9 Insert in K148

a. **VERB 33**, ENTER

6.2.20.2.10 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00160
c.	R2		-00160
d.	R3		+00160

6.2.20.2.11 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+2.11±0.27 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+2.11±0.27 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+2.11±0.27 VRMS

6.2.20.2.12 Insert in K148

a. **VERB 33**, ENTER

6.2.20.2.13 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00135
c.	R2		-00135
d.	R3		+00135

6.2.20.2.14 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+1.78±0.23 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-1.78±0.23 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+1.78±0.23 VRMS

6.2.20.2.15 Insert in K148

a. **VERB 33**, ENTER

6.2.20.2.16 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00090

6.2.20.2.26 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-1.78±0.23 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+1.78±0.23 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-2.11±0.27 VRMS

6.2.20.2.27 Insert in K148

a. VERB 33, ENTER

6.2.20.2.28 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		-00160
c.	R2		+00160
d.	R3		-00384

6.2.20.2.29 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-2.11±0.27 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+2.11±0.27 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.06±0.66 VRMS

6.2.20.2.30 Insert in K148

a. VERB 33, ENTER

6.2.20.2.31 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		-00384
c.	R2		+00384
d.	R3		-00385

6.2.20.2.32 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.06±0.66 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.06±0.66 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	-5.06±0.66 VRMS

6.2.20.2.33 Insert in K148

a. VERB 33, ENTER

6.2.20.2.34 Observe on CRT

a.	V 06	N01	Flashing
b.	R1		-00385
c.	R2		+00385
d.	R3		+00000

6.2.20.2.35 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-5.06±0.66 VRMS
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+5.06±0.66 VRMS
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	0.00±0.06 VRMS

6.2.20.2.36 Insert in K148

a.	V 21	N01	ENTER
b.	02545		ENTER
c.	02637		ENTER
d.	V 33		ENTER

6.2.20.2.37 Observe on CRT

a.	V 06	N02	Flashing
b.	NO ATT		ON
c.	R1		+00000 approximately
d.	R2		+00000 approximately
e.	R3		+00000 approximately

6.2.20.3 TVC Test

6.2.20.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN. Set the OPTICS ZERO switch to OFF.

6.2.20.3.3 Insert in K148

a. VERB 33, ENTER

6.2.20.3.4 Observe on CRT

a.	V 01	N 10	Flashing
b.	R1		X7373
c.	R3		00030

6.2.20.3.5 Insert in K148

a. V 33 ENTER

6.2.20.3.6 Observe on CRT

a.	V 01	NOUN 10	Flashing
b.	R1		37777
c.	R3		00031

6.2.20.3.7 Insert in K148

a. V 33 ENTER

6.2.20.3.8 Observe on CRT

a.	V 06	N 02	Flashing
b.	R1		+00385
c.	R2		-00385
d.	R3		+00003

6.2.20.3.9 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	+10.12±1.00 VRMS
b.	CG 3721	SHAFT CDU DAC OUTPUT	-10.12±1.00 VRMS

6.2.20.3.10 Insert in K148

a. VERB 33, ENTER

6.2.20.3.11 Observe on CRT

a. V 06 N 02 Flashing
b. R1 +00384
c. R2 -00384
d. R3 +00003
e. NO ATT OFF

6.2.20.3.12 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +10.12±1.00 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT -10.12±1.00 VRMS

6.2.20.3.13 Insert in K148

a. VERB 33, ENTER

6.2.20.3.14 Observe on CRT

a. V 06 N 02 Flashing
b. R1 +00160
c. R2 -00160
d. R3 +00003

6.2.20.3.15 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +4.22±0.42 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT -4.22±0.42 VRMS

6.2.20.3.16 Insert in K148

a. VERB 33, ENTER

6.2.20.3.17 Observe on CRT

a. V 06 N 02 Flashing
b. R1 +00135
c. R2 -00135
d. R3 +00003

6.2.20.3.18 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +3.56±0.36 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT -3.56±0.36 VRMS

6.2.20.3.19 Insert in K148

a. VERB 33, ENTER

6.2.20.3.20 Observe on CRT

a.	V 06	N 02	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00003

6.2.20.3.21 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	+2.38±0.24 VRMS
b.	CG 3721	SHAFT CDU DAC OUTPUT	-2.38±0.24 VRMS

6.2.20.3.22 Set the OPTICS SPEED Switch on the Indicator Control Panel to HI.

6.2.20.3.23 Insert in K148

a. VERB 33, ENTER

6.2.20.3.24 Observe on CRT

a.	V 06	N 02	Flashing
b.	R1		+00000
c.	R2		+00000
d.	R3		+00003

6.2.20.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a.	CG 3722	TRUNNION CDU DAC OUTPUT	0.00±0.12 VRMS
b.	CG 3721	SHAFT CDU DAC OUTPUT	0.00±0.12 VRMS

6.2.20.3.26 Insert in K148

a. VERB 33, ENTER

6.2.20.3.27 Observe on CRT

a.	V 06	N 02	Flashing
b.	R1		-00090
c.	R2		+00090
d.	R3		+00003

6.2.20.3.28 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	-2.38±0.24 VRMS
b.	CG 3721	SHAFT CDU DAC OUTPUT	+2.38±0.24 VRMS

6.2.20.3.29 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Indicator Control Panel to ZERO for 30 seconds, then return to OFF.

6.2.20.3.30 Insert in K148

a. VERB 33, ENTER

6.2.20.3.31 Observe on CRT

a. V 06 N 02 Flashing
b. R1 -00135
c. R2 +00135
d. R3 +00003

6.2.20.3.32 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -3.56±0.36 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT +3.56±0.36 VRMS

6.2.20.3.33 Insert in K148

a. VERB 33, ENTER

6.2.20.3.34 Observe on CRT

a. V 06 N 02 Flashing
b. R1 -00160
c. R2 +00160
d. R3 +00003

6.2.20.3.35 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -4.22±0.42 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT +4.22±0.42 VRMS

6.2.20.3.36 Insert in K148

a. VERB 33, ENTER

6.2.20.3.37 Observe on CRT

a. V 06 N 02 Flashing
b. R1 -00384
c. R2 +00384
d. R3 +00003

6.2.20.3.38 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	-10.12±1.00 VRMS
b.	CG 3721	SHAFT CDU DAC OUTPUT	+10.12±1.00 VRMS

6.2.20.3.39 Insert in K148

a. VERB 33, ENTER

6.2.20.3.40 Observe on CRT

a.	V 06	N 02	Flashing
b.	R1		-00385
c.	R2		+00385
d.	R3		+00003

6.2.20.3.41 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	-10.12±1.00 VRMS
b.	CG 3721	SHAFT CDU DAC OUTPUT	+10.12±1.00 VRSM

6.2.20.3.42 Insert in K148

a.	V 34		ENTER
b.	V 40	N 20	ENTER
c.	V 41	N 20	ENTER
d.	+00000		ENTER
e.	+00000		ENTER
f.	+00000		ENTER

APPENDIX I

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	1	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	1	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	2	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	1	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	1	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	1	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	1	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2	2.5 VDC TM BIAS	+2.50 ± 0.06 VDC	0%
CG 1201	2	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	1	IMU 28V .8KC 5% -90° RMS	28.0 ± 1.4 VRMS	0.33%
CG 1203	1	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	0.33%
CG 1207	1	PH DIFF IMU 5% 0°, -90°	-90 ± 10°	2.3%
CG 1211	1	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	0.33%
CG 1212	1	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	0.33%
CG 1220	1	PH DIFF OPTX 1% IMU 1%	0° ± 10°	2.3%
CG 1331	2	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	1	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	2.3%
CG 1500	1	+28 VDC IMU OPERATE BUS	28.0 ± 3 VDC	0%
CG 1510	1	+28 VDC IMU STANDBY BUS	28.0 ± 3 VDC	0%
CG 1520	1	+28 VDC CMC OPERATE BUS	28.0 ± 3 VDC	0%
CG 1530	1	+28 VDC OPTX OPERATE BUS	28.0 ± 3 VDC	0%
CG 2001	2	X PIPA SG O/P	5 VRMS max	3%
CG 2021	2	Y PIPA SG O/P	5 VRMS max	0.23%
CG 2041	2	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	1	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2112	2	IG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2113	2	IG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2117	2	IG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	2.0%
CG 2120	1	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	0%
CG 2138	1	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2142	2	MG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2143	2	MG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2147	2	MG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	2.0%
CG 2150	1	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 2168	1	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2172	2	OG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2173	2	OG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2177	2	OG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	2.0%
CG 2180	1	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 1042	1	+120 VDC PIPA SUP NOISE RMS	1.5 VRMS max	0%
CG 1053	1	+20 VDC PIPA SUP NOISE RMS	1.0 VRMS max	0%
CG 1071	1	+4 VDC CDU SUP NOISE RMS	0.10 VRMS max	0%
CG 1501	1	+28V IMU OPERATE BUS NOISE RMS	1.0 VRMS max	0%
CG 1511	1	+28V IMU STANDBY BUS NOISE RMS	1.0 VRMS max	0%
CG 1521	1	+28V CMC OPERATE BUS NOISE RMS	2.0 VRMS max	0%
CG 1531	1	+28V OPTX OPERATE BUS NOISE RMS	2.0 VRMS max	0%

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 2219	1	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2220	1	IG CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 2221	1	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS at null	0.29%
CG 2249	1	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2250	1	MG CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 2251	1	MG CDU COARSE ERROR	0.0 ± 0.68 VRMS at null	0.29%
CG 2279	1	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2280	1	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	0.29%
CG 2281	1	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	0.29%
CG 2300	1	PIPA TEMPERATURE	130.5 ± 1.5°F Operate Mode	2%
CG 3011	2	TRUNNION CDU FINE ERROR	0.0 ± 0.07 VRMS at null	1.0%
CG 3021	1	SHAFT CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 3117	1	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	1.1%
CG 3118	1	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	1.1%
CG 3140	1	SXT SHAFT TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3145	1	SXT SHAFT MTR CONTROL WINDING	+0.50 to +4.00 VRMS Med Rate	1.1%
CG 3150	1	SXT TRUNNION TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3155	1	SXT TRUNNION MTR CONTROL WINDING	+0.25 to +2.00 VRMS Med Rate	1.1%
CG 3160	1	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3170	1	SCT TRUNNION TACH O/P	0.85 ± 0.35 VRMS at Hi Rate	1.1%
CG 3721	1	SHAFT CDU DAC O/P	10.12 ± 1.00 VRMS at 17°	1%
CG 3722	2	TRUNNION CDU DAC O/P	10.12 ± 1.00 VRMS at 17°	1%
CG 4300	2	CMC TEMP	87.5± 42.5°F	0.0%
CG 6020	1	PIPA CAL MODULE TEMP	72.5 ± 27.5°F	0.23%
CG 6021	1	IMU 800 cps 5% TEMP (PSA)	90 ± 30°F	0.23%
CG 2301	1	IRIG TEMPERATURE	135 ± 2.5°F in Operate	2%
CG 1021	1	+14V CMC SUPPLY NOISE RMS	0.2 VRMS max	0%
CG 1031	1	+4 CMC SUPPLY NOISE RMS	0.2 VRMS max	0%

PSAAM OUTPUT is the source of Link 1 signals.
SCA OUTPUT is the source of Link 2 signals.

NUMBER	REVISION LETTER								PAGE

ADDENDUM I

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for CSM 101.

Addition 1. Add paragraph 6.1.1.7 as follows:

6.1.1.7 Data from the on-board tape recorder shall be made available and the following signals verified:

a. IG TORQUE MOTOR CURRENT (CG 2120) shall be less than 0.125 amp max.
b. OG TORQUE MOTOR CURRENT (CG 2180) shall be less than 0.125 amp max.
c. MG TORQUE MOTOR CURRENT (CG 2150) shall be less than 0.125 amp max.

Addition 2. Paragraph 6.2.1.5.6, change the last sentence to read as follows:

On the Event Recorder verify that the IMU HTR Current switch discrete (CG 2302 Link 2) is on and that the IMU Blower Current discrete (CG 2303 Link 2) is OFF over the last 2 hour period (occasionally discretes may cycle).

Addition 3. Add paragraph 6.2.4.6.1 as follows:

6.2.4.6.1 On the analog recorder verify that (CG 1211 Link 2, OPTICS 28V 800 cps 1% 0 deg) RMS voltage is 28.0±0.06 VAC.

Addition 4. Add Paragraph 6.2.20.2.5.1 and 6.2.20.2.32.1 as follows:

6.2.20.2.5.1 Verify on the analog recorder the following signals:

a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT +5.06±0.66 VRMS
b. CM 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT -5.06±0.66 VRMS
c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT +5.06±0.66 VRMS

6.2.20.2.32.1 Verify on the analog recorder the following signals:

a. CG 2279 Link 2 ROLL ATT ERROR - CDU DAC OUT -5.06±0.66 VRMS
b. CG 2219 Link 2 PITCH ATT ERROR - CDU DAC OUT +5.06±0.66 VRMS
c. CG 2249 Link 2 YAW ATT ERROR - CDU DAC OUT -5.06±0.66 VRMS

Addition 5. Paragraph 6.1.2.1., add new Paragraph 6.1.2.1.5 as follows:

6.1.2.1.5 Data from the on-board tape recorder shall be made available and the following signals verified.

a. VIB NB ROLL (CG 6001)
b. VIB NB PITCH (CG 6002)
c. VIB NB YAW (CG 6003)

Addition 6. Replace Paragraph 6.2.3.1.13 with the following:

6.2.3.1.13 30 minutes after switching from Standby mode to the Operate mode record the IRIG temperature. The recorded IRIG temperature shall be within 0.5 deg F. of the Operate stabilized IRIG temperature determined below.

Add the following sentence to Paragraph 6.2.3.1.14:

Record the Operate mode stabilized IRIG temperature. The Operate mode stabilized IRIG temperature shall be 135±2.5° F.

Paragraph 6.2.5.2.16, add the following to Table VI:

14 CG 2301 IRIG TEMPERATURE

Addition 7. Paragraph 6.1.1.6, add item "f" as follows:

f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.

Addition 8. Replace Paragraph 6.2.3.1.2 with the following:

6.2.3.1.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Switch and selectors on the G&N Indicator Control Panel shall be set as follows.

a. OPTICS MODE to ZERO
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to MED
d. TELESCOPE TRUNNION to SLAVE to SXT
e. RETICLE BRIGHTNESS to minimum brightness position

Addition 9. Replace Paragraph 6.2.5.1.2 with the following:

6.2.5.1.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the following switches on the G&N Indicator Control Panel to the positions designated.

a. OPTICS MODE to ZERO
b. CONTROLLER MODE to DIRECT
c. CONTROLLER SPEED to LO
d. TELESCOPE TRUNNION to SLAVE to SXT
e. RETICLE BRIGHTNESS to minimum brightness position

Addition 10. Replace Paragraph 6.2.5.2.1 with the following:

6.2.5.2.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set or verify the following G&N Indicator Control Panel switches to the position indicated.

a. CONDITION LAMPS to ON
b. OPTICS MODE to ZERO
c. CONTROLLER COUPLING to DIRECT
d. CONTROLLER SPEED to LO
e. TELESCOPE TRUNNION to SLAVE to SXT
f.. RETICLE BRIGHTNESS to minimum brightness position

Addition 11. Replace Paragraph 6.2.5.3.6 with the following:

6.2.5.3.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Insure that the following switches are set to the positions indicated:

a. CONTROLLER COUPLING to DIRECT
b. OPTICS MODE to ZERO
c. TELESCOPE TRUNNION to SLAVE to SXT
d. TRACKER to OFF
e. CONTROLLER SPEED to LO
f. CONDITION LAMPS to ON
g. UP TELEMETRY to ACCEPT

Addition 12. Replace Paragraph 6.2.9.23 with the following:

6.2.9.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

Addition 13. Replace Sections 6.2.10 through 6.2.13 with the following:

6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On Procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

a. VERB 41, NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

a. TELESCOPE TRUNNION to SLAVE to SXT
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to HI

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

a. R1 = +0.00° +0.02°, -0.03° (Shaft Angle)
b. R2 = +0.000° +0.006°, -0.007° (Trunnion LOS Angle)

6.2.10.5.1 Enter the following

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.2 Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS BACKUP MODE TEST

6.2.10.6 Insert the Inflight Tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +5 deg. Remove the tool from the trunnion tool input.

6.2.10.7 Insert the Inflight Tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3 to -3 to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.

6.2.10.8 Insert the Inflight Tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion Turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 Optics Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure before proceeding.

INITIALIZATION

6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator control panel to the position indicated.

a. TELESCOPE TRUNNION to SLAVE to SXT
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to HI

6.2.11.4 Set up the analog recorders to monitor the following measurements.

a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS MODE switch to MAN.

RESOLVED MODE PHASING AND IMAGE RATE TEST

6.2.11.7 Using the Optics Control Stick, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and CONTROLLER SPEED switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.

6.2.11.10 Quickly displace the Optics Control Stick 45±10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45±10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be +225±10.00 degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the Trunnion measurement. The elapsed time shall be +19 to +32 seconds.

CSM AMPLIFIER SHAFT AND TRUNNION DRIVE TEST

6.2.11.12 Set the CONTROLLER COUPLING switch to DIRECT. Again using the Optics Control Stick, drive the optics until R1 = +225.00 and R2 = +10.000. Set the CONTROLLER COUPLING switch to RSLV.

6.2.11.13 While sighting on the optical target through the SCT eyepiece, displace the Optics Control Stick fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the Optics Control Stick when the target image reaches the edge of the SCT field of view.

6.2.11.14 Enter VERB 34 in the DSKY. Press the ENTER pushbutton.

6.2.11.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT. Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2 Turn-on Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1 Set/verify the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set TRACKER switch to OFF. Verify the following:

a. +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.

b. CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.

c. CG 1212 OPTX 800 cps 5% -90 ph not flashing on CRT.

6.2.12.2 Enter the following sequence into the K-Start.

a. VERB 41, NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.12.3 Insure that the optics control switches on the G&N Indicator Control Panel are set as follows:

a. OPTICS MODE to MAN
b. CONTROLLER SPEED to LO
c. CONTROLLER COUPLING to DIRECT
d. TELESCOPE TRUNNION to SLAVE to SXT

6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

6.2.12.5 Resolution Checks

6.2.12.5.1 Sight through the SXT eyepiece. Using the Optic Control Stick, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engraving at the center of the field of view.

6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.

6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.

6.2.12.6 Slave Telescope Mode Checks

6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start, press the ENTER pushbutton.

6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. Wait 15 seconds.

6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC shaft angle and the Shaft CDU angle shall be ±0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ±0.22 deg or less.

6.2.12.6.4 Place the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Shaft and Trunnion CDU's until R1 = 035.00±0.10 deg and R2 = +35.000±0.100 deg, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record R1 and R2. The difference between the TPAC Shaft angle and Shaft CDU angle shall be ±0.11 deg or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be ±0.22 deg or less.

6.2.12.6.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.

6.2.12.6.6 Set the TELESCOPE TRUNNION switch to SLAVE to SXT position.

6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.

NOTE: If needed to reduce external light, place a photographer hood over the optics head and retroreflecting prism.

6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of step 6.2.12.6.11.

6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).

6.2.12.6.10 Set the TELESCOPE TRUNNION switch to 0° position.

6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.

6.2.12.6.12 Remove the Retroreflecting Prism.

6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.

6.2.12.6.14 While sighting into the SCT eyepiece, set the TELESCOPE TRUNNION switch to 25° and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25° below the center of the field of view.

6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00±0.22 deg.

6.2.12.6.16 Set the TELESCOPE TRUNNION switch to SLAVE to SXT.

6.2.12.7 SXT Parallelism Tests

6.2.12.7.1 Using the Optics Control Stick drive the SXT StLOS Trunnion to +15.000° ±2° as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ±0.10 degrees as indicated by R1 of the DSKY.

6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.

6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.

6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO.

6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.

6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.

6.2.12.7.7 Set the OPTICS MODE switch to MAN. Using the Optics Control Stick drive the SXT Trunnion angle to 85.00±5 degrees as indicated on R2 of the DSKY. Set the CONTROLLER SPEED switch to LO and drive the SXT Trunnion to +90.000 degrees ±0.100 degree as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00±0.10 degree as indicated by R1 on the DSKY.

6.2.12.7.8 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Control Stick to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000±0.10 degrees.

6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12.8 **Shaft and Trunnion Positional Accuracy Checks**

6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO After 15 seconds, return the selector to Manual.

6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical Target No. 1 on the G&N Installation Fixture Model A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.

6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with Optical Target No. 2 on A23-097. Set the CONTROLLER SPEED switch to LO as the target is approached.

6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.

6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds set the switch to CMC.

6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the enter pushbutton.

6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.

6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.

6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MANUAL.

6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.

6.2.13 Optics Slew Rate Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.13.1 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CB 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT. Set TRACKER switch to OFF.

6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

a. VERB 41 NOUN 20,ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.

a. TELESCOPE TRUNNION to SLAVE to SXT
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to HI

6.2.13.4 Monitor MARK Command by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.

TRUNNION SLEW RATE - HI SPEED

6.2.13.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

6.2.13.5.1 During the Trunnion Slew Rate Test HI Speed, monitor and verify the following signals on the CRT.

a. SXT TRUNNION TACH O/P (CG 3150 LINK 2) shall be 3.3±1.3 VRMS
b. SCT TRUNNION TACH O/P (CG 3170 LINK 2) shall be -0.85±0.35 VRMS

NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.

6.2.13.6 While slewing the optics, record the SXT TRUN SERVO error (CG 3118); it shall be between -0.25 and 2.0 VRMS.
Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.7 Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

a. Difference between R2 displays = _ _ _ _ _ _ (Δ trunnion angle)
b. Difference between R3 displays = _ _ _ _ _ _ (Δ time)
c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \_ . \_$ deg/sec

The Trunnion Slew Rate shall be 10±2 deg/sec.

SHAFT SLEW RATE - HI SPEED

6.2.13.8 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.8.1 During the Shaft Slew Rate Test - Hi Speed, monitor and verify the following signals on the CRT.

a. SXT SHAFT TACH O/P (CG 3140 Link 2) shall be 3.3±1.3 VRMS
b. SCT SHAFT TACH O/P (CG 3160 Link 2, shall be -3.3±1.3 VRMS

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9 While slewing the optics, record the SXT SHAFT SERVO error (CG 3117); it shall be between -0.25 and -2.0 VRMS.

6.2.13.9 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R1 = ±XXX.XX (shaft angles in deg)
b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.10 Perform the following calculations:

a. Difference between R1 displays = _ _ _ . _ _ (Δ shaft angle)
b. Difference between R3 displays = _ _ _ . _ _ (Δ time)
c. $\dfrac{\Delta\text{shaft angle}}{\Delta\text{time}} = \_\,\_\,.\,\_$ deg/sec

The Shaft Slew Rate shall be 19.5±3.9 deg/sec.

TRUNNION SLEW RATE - MED SPEED

6.2.13.11 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155) and SXT TRUN TACH (CG 3150) signals on the CRT while slewing the optics. CG 3155 shall be +0.25 to +2.00 VRMS, and CG 3150 shall be +0.33 ±0.13 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R2 = ±XX.XXX (trunnion LOS angle in deg)
b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13 Perform the following calculations:

a. Difference between R2 displays = __ . ___ (Δ trunnion angle)
b. Difference between R3 displays = ___ . __ (Δ time)
c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \_ . \_\_$ deg/sec

The Trunnion Slew Rate shall be 1.0±0.2 deg/sec.

SHAFT SLEW RATE - MED SPEED

6.2.13.14 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS Mode switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Record the SXT SHAFT MTR control winding (CG 3145) and SXT SHAFT TACH (CG 3140) signals on the CRT while slewing the optics. CG 3145 shall be +0.50 to +4.00 VRMS, and CG 3140 shall be 0.33±0.13 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R1 = ±XXX.XX (shaft angle in deg)
b. R3 = +XXX.XX (time in seconds)

After display has changed, again record the values of R1 and R3.

6.2.13.16 Perform the following calculations:

a. Difference between R1 displays = ___ . __ (Δ shaft angle)
b. Difference between R3 displays = ___ . __ (Δ time)
c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \_ . \_\_$ deg/sec

The Shaft Slew Rate shall be 2.0±0.4 deg/sec.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the Controller SPEED switch to LO. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.17.1 During the Trunnion Slew Rate Test-Lo Speed, monitor and verify the following signal on the CRT.

a. TRUNNION CDU FINE ERROR (CG 3011 Link 2) ±.07 VRMS MAX

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R2 = ±XX.XXX (trunnion LOS angle in deg)
b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19 Perform the following calculations:

a. Difference between R2 displays = XX.XXX (Δ trunnion angle)
b. Difference between R3 displays = XXX.XX (Δ time)
c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} = \_ . \_\_$ deg/sec

The Trunnion Slew Rate shall be 0.10±0.02 deg/sec

SHAFT SLEW RATE - LO SPEED

6.2.13.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Monitor MARK Command by entering Verb 06 NOUN 56 in K-148. Press the ENTER pushbutton.

6.2.13.20.1 During the Shaft Slew Rate Test - Lo Speed, monitor and verify the following signal on the CRT.

a. SHAFT CDU FINE ERROR (CG 3021 Line 2) ±.07 VRMS MAX

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R1 = ±XXX.XX (shaft angles in deg)
b. R3 = +XXX.XX (time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22 Perform the following calculations:

a. Difference between R1 displays = $\_\_\_ . \_\_$ (Δ shaft angle)
b. Difference between R3 displays = $\_\_\_ . \_\_$ (Δ time)
c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \_ . \_\_$ deg/sec

The Shaft Slew Rate shall be 0.20±0.04 deg/sec

OPTICS HAND CONTROLLER DRIFT RATE CHECK-LO SPEED

6.2.13.23 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

6.2.13.24 Press the MARK pushbutton and record the display in R1, R2, and R3. Approximately 60 seconds after the first MARK, again press the first MARK pushbutton and record the new data displayed in R1, R2 and R3. The data displayed is in the following form:

a. R1 = ±XXX.XX (shaft angle in deg)
b. R2 = ±XX.XXX (trunnion LOS angle in deg)
c. R3 = +XXX.XX (time in seconds)

6.2.13.25 Perform the following calculations:

a. Difference between R1 displays = ______ (Δ shaft angle)
b. Difference between R2 displays = ______ (Δ trunnion angle)
c. Difference between R3 displays = ______ (Δ time)
d. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} =$ ____ deg/sec (Shaft Drift Rate)

Shall be less than 0.0333 deg/sec.

e. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}} =$ ____ deg/sec (Trunnion Drift Rate

Shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Addition 14. Replace Paragraph 6.2.17.5 and 6.2.17.20 with the following:

6.2.17.5 On the G&N Indicator Control Panel, set the following switches to the position indicated.

a. TELESCOPE TRUNNION to SLAVE to SXT
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to LO
d. OPTICS MODE to MAN

6.2.17.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.

Addition 15. Replace Paragraphs 6.2.18.10.1, 6.2.18.10.2, 6.2.18.19, 6.2.18.20, and 6.2.18.22 with the following:

6.2.18.10.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Between 235 minutes and 240 minutes from T_0 set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.18.10.2 Enter the following into the DSKY:

a. VERB 21 NOUN 03 ENTER
b. 02663 ENTER
c. +XXX.XX±000.01 ENTER (Target No. 1 Az)
d. Press ENTER pushbutton
e. 02664 ENTER
f. +XXX.XX±000.01 ENTER (Target No. 2 Az)
g. Press ENTER pushbutton
h. 02665 ENTER
i. +00.000 ENTER (Target No. 1 EL)
j. Press ENTER pushbutton
k. 02666 ENTER
l. +00.000 ENTER (Target No. 2 EL)

On the G&N Indicator Control Panel, set the OPTICS MODE switch to MAN and the CONTROLLER SPEED switch to HI. Drive the St. LOS to the approximate position of Target No. 1. Set the CONTROLLER SPEED switch to LO.

NOTE: Read the following 10 steps before proceeding. These are time critical steps and must be performed as rapidly as possible.

6.2.18.19 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT StLOS to the approximate position of Target 2.

6.2.18.20 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT StLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.

6.2.18.22 Enter VERB 34 into the K-Start. Press the ENTER pushbutton. Observe the PROGRAM display on the CRT and DSKY's indicate 02. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS MODE switch on the G&N Indicator Control Panel to Zero.

Addition 16. Replace Paragraph 6.2.20.3.2, 6.2.20.3.22, and 6.2.20.3.29 with the following:

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control Panel to MAN.

6.2.20.3.22 Set the OPTICS CONTROLLER SPEED switch on the Indicator Control Panel to HI.

6.2.20.3.29 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (TelescopeTrunnion slaved to SXT). Set the OPTICS MODE switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.

ADDENDUM II

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems containing SUNDIAL C test ropes. Refer to Drawing 2014999 to define further which test ropes and jumper modules shall be installed.

Change 1: Paragraphs 6.2.9.1.4, 6.2.9.2a, 6.2.9.3a, 6.2.9.5a, 6.2.9.6a, 6.2.9.7a, 6.2.9.8, 6.2.9.10a, 6.2.9.11a, 6.2.9.13a, 6.2.9.15a, 6.2.9.16a, 6.2.9.22. In each of these paragraphs change "VERB 06 NOUN XX flashing" to "VERB 33 NOUN XX flashing."

Change 2: Paragraphs 6.2.20.2.2a, 6.2.20.2.4a, 6.2.20.2.7a, 6.2.20.2.10a, 6.2.20.2.13a, 6.2.20,2.16a, 6.2.20.2.19a, 6.2.20.2.22a, 6.2.20.2.25a, 6.2.20.2.28a, 6.2.20.2.31a, 6.2.20.2.34a, 6.2.20.2.37a, 6.2.20.3.8a, 6.2.20.3.11a, 6.2.20.3.14a, 6.2.20.3.17a, 6.2.20.3.20a, 6.2.20.3.24a, 6.2.20.3.27a, 6.2.20.3.31a, 6.2.20.3.34a, 6.2.20.3.37a, 6.2.20.3.40a; in each of these steps, change "V06" to "V33".

Change 3: Paragraph 6.2.16.7.19 Change FROM: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
00411		ENTR
00020		ENTR
VERB 33		ENTR

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
02504		ENTR
00020		ENTR
VERB 33		ENTR

Change 4: Paragraph 6.2.16.7.33 Change FROM: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00405		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 33		ENTR

ADDENDUM II

Change 4
(Continued)

Change TO: On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
02500		ENTR
00020		ENTR
VERB 21	NOUN 01	ENTR
02502		ENTR
77757		ENTR
VERB 33		ENTR

ADDENDUM III

SCOPE. The following changes are required to make ND1002325 applicable on G&N System technical support documentation for CSM 2TV-1.

Change 1: Make the changes as specified in Additions 11 through 20 of Addendum I. Delete the following paragraphs from Addition 17: 6.2.13.5.1, 6.2.13.8.1, 6.2.13.17.1, 6.2.13.20.1.

APOLLO G&N Specification
ND1002325 REV AC
Original Issue Date:
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Class A Release

POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				DE	NASA
5/25/70	AB	38167	15-38, 42, 50-56, 59-61, 64, 67,	EA	MDH
			71, 85, 91, 92, 105, 113, 121, 122,		
			126, 130-172; was 172 pages,		
			now 169 pages.		
9/25/70	AC	38248	16, 17, 24, 26, 33, 35-37, 40-42, 46,	EA	MDH
			50, 51, 56, 64, 67, 74, 76-169; was		
			169 pages, now 171 pages.		

This specification consists of page 1 to 171 including Appendix I, pages 146-147, Addendum I, pages 148-168, Addendum II, page 169-170 and Addendum III, page 171.

APPROVALS	Not required per CCA-497-0274 **NASA/MSC**	**MIT/IL**	R. D. Petryk	D.A. Ziemer
			ACSP	

Record the value of R1.

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

NOTE: If the INLINK MONITOR program as found on K-START Tape N05C113-K10554-XX, CSM S/C Test Tape N/R Site is loaded, Channel 77 can be monitored and recorded on the CRT. Also, the contents of CMC register 45 (ZG 8114) may be monitored on the CRT. The contents of register 45 must be zero before any K-START or UDL transmissions are attempted.

5.13.5.1 The contents of R1 should be interpreted as follows:

Channel 77 Code (Octal)		Alarm Source
001	*[1] *[2]	Parity Fail (F Memory)
003	*[1] *[2]	Parity Fail (E Memory)
004	*[2]	TC Trap
010	*[2]	Rupt Lock
020	*[2]	Nightwatchman
040	*[3]	Voltage Fail
100		Counter Fail
200		Scaler Fail
400		Scaler Double Frequency Alarm

*[1] NOTE: Parity Fail will occur either in E or F Memory, but not in combination.

*[2] NOTE: Depending on when the various alarms occur, a Counter Fail Alarm may also occur, and Bit 7 will therefore be set also.

*[3] NOTE: Other alarms will probably occur before the Voltage Fail Alarm occur, in which case the contents of Channel 77 will contain the octal sum of all the alarms but it will contain the Voltage Fail Code.

6.2.2.5.8 Set the UP TLM switch on the MAIN DISPLAY Panel to BLOCK. Verify that the BLOCK UPLINK discrete is ON. CRT is ON.

6.2.2.5.9 On K-148 insert VERB. Verify VERB indication on the DSKY and CRT does not change.

6.2.2.5.10 Set the UP TLM switch on the MAIN DISPLAY Panel to ACCEPT. Verify that the BLOCK UPLINK discrete is OFF. Remove the Block Uplink Override R-START.

6.2.2.5.11 On K-148 insert VERB 36. Press the ENTER pushbutton.

6.2.2.5.12 Verify K-START Tape N05C113 K10554-XX, CSM S/C TEST TAPE N/R SITE is on the K-START Tape Reader.

6.2.2.5.12.1 Start Tape Reader.

6.2.2.5.12.2 When the Tape Reader stops, verify:

R1 = +05003
R2 = +10554
R3 = -000XX (XX tape revision number)

6.2.2.5.12.3 Start the Tape Reader.

6.2.2.5.12.4 When the Tape Reader stops, verify the following:

(a) R1 = 00101

(b) On CRT, the two most significant octal digits of CH77 are incrementing.

6.2.5.2.3 Energize the G&N COMPUTER MN A and MN B breakers on the right hand circuit breaker panel (breakers pushed in). Enter VERB 61 into K-148 and press the ENTER pushbutton. Verify +14 and +4 VDC CMC power supply outputs on CRT display. Voltages shall be +14.0±0.4 VDC (CG1020) and +4.0±0.2 VDC (CG1030).

NOTE: RESTART and/or PROG alarm may illuminate with V05N31 and R_1=01105. CMC warning (for approximately 10 secs.) and MASTER ALARM may also occur. If these indications occur in any combination press RSET on the DSKY and reset MASTER ALARM.

On DSKY verify TEMP light is ON. On the G&N Indicator Control Panel verify PGNS light is ON.

6.2.5.2.4 Energize the G&N IMU HTR MN A and MN B breakers on the right hand circuit breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify TEMP light on DSKY is extinguished. Verify PGNS light on the G&N Indicator Control Panel is extinguished.

6.2.5.2.4.1 Set/verify the following switches on the PSAAM:

a. PSAAM POWER to ON.
b. INHIBIT VOLTAGE FAIL to OFF.

6.2.5.2.5 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS-NUMERICS control on both left hand circuit breaker panel and LEB Light Control Panel.

6.2.5.2.6 Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton on K148. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared. Verify PROG = 00.

6.2.5.2.7 Enter the following into K-148:

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

6.2.5.2.8 Initiate CMC Self-Test by entering the following into the K148:

a. VERB 21, NOUN 27, ENTER
b. 77777, ENTER
c. VERB 15, NOUN 01, ENTER
d. 01366, ENTER

6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed.

a. VERB 05, NOUN 31
b. R1 = 01102
c. R2 = XXXXX c (SFAIL)
d. R3 = XXXXX c (ERCOUNT)

6.2.5.2.8.2 Terminate the monitor routine by entering the following into the DSKY

VERB 34, ENTER

6.2.5.2.8.3 Terminate Self-Test by entering the following into the K-Start:

a. VERB 21, NOUN 27, ENTER
b. 00000, ENTER

6.2.5.2.8.4 Verify Tape Reader is loaded with tape N05C113-K10554-XX at Section 00101. Start Tape Reader.

6.2.5.2.8.4.1 When the Tape Reader stops, verify:

a. R1 = 00101
b. On CRT, CH77 two most significant octal digits incrementing.

6.2.5.2.8.5 Verify Tape Reader is loaded with tape N05C113-K10554-XX to Section 00202. Start tape reader.

6.2.5.2.8.5.1 When the Tape Reader stops, verify:

a. R1 = 00202
b. The CMC Activity light is ON.

NOTE: If a VERB 36 is performed after the tape is loaded, enter the following on the DSKY to recall the CMC Activity light ON:

```
VERB 25 NOUN 26 ENTR
01000           ENTR
01770           ENTR
00007           ENTR
VERB 30         ENTR
```

An exception is the VERB 36 performed when entering Voltage Margin Test (6.2.19). After completing Voltage Margin Test, enter the above sequence.

NOTE: Allow two (2) hours to elapse before proceeding to Step 6.2.5.2.9, with the following exceptions:

a. If the G&N System has been in power off state for less than 5 days with the gimbals in the following positions:

   X = 000.00±005.00 deg
   Y = 000.00±005.00 deg
   Z = 090.00±005.00 deg

   or has been in power off state for less than 12 days with gimbals in the following positions:

   X = 000.00±001.00 deg
   Y = 000.00±001.00 deg
   Z = 090.00±001.00 deg

   and the system has not been moved, then allow only 15 minutes to elapse before proceeding.

b. If the G&N System has been turned off with the gimbals in the unparked position for less than two (2) hours, allow a warmup time equal to the time off, but not less than 15 minutes to lapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU operate power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.6.2.2 On K-148 enter the following sequence:

VERB 57 ENTR
00004 ENTR

6.2.6.2.3 Observe VERB 16 NOUN 20 displayed on CRT. The NO ATT discrete shall appear momentarily then go OFF. Verify that the PROGRAM displayed on the CRT indicates 07.
Enter VERB 34 into K148 and press the ENTER pushbutton.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be 980.00000± 05.00000 cm/sec^2.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed on R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always be 00000. The horizontal earth rate shall be 00000.83000±0.1000 earth rate units.

6.2.6.3 Test Termination

6.2.6.3.1 Verify K-START Tape N05C113-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00203.

6.2.6.3.2 Start the Tape Reader.

6.2.6.3.3 When the Tape Reader stops, verify the following:

(a) R1 = 00203
(b) CMC Activity light ON.
(c) On CRT, the two most significant octal digits of CH77 incrementing.
(d) The NO ATT light is ON.

6.2.7.4.8 Enter the following sequence in the K-Start:

a. VERB 42, press ENTR
b. VERB 33, press ENTR

6.2.7.4.9 Start analog recorders.

6.2.7.4.10 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs (approximately 5 minutes), stop the recorders.

6.2.7.4.11 Verify K-START Tape N05C113-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00203.

6.2.7.4.12 Start the Tape Reader.

6.2.7.4.13 When the Tape Reader stops, verify the following:

(a) R1 = 00203

(b) CMC Activity light ON.

(c) On CRT, the two most significant octal digits of CH77 incrementing.

(d) The NO ATT light is ON.

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque Motor current traces and disregard all transients on the CDU Fine Error and CDU Coarse Error traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ±70 mv rms. The CDU Coarse Error measurement shall not exceed ±680 mv rms.

6.2.9.1.1.2 Proceed to 6.2.9.1.3 after manual entry of above data.

6.2.9.1.2 Tape loaded input.

6.2.9.1.2.1 Verify Tape N05C113-K10554-XX is on the Tape Reader and at Section 00300.

6.2.9.1.2.2 Start the Tape Reader.

6.2.9.1.2.3 When the Tape Reader stops, verify:

R1 = 00300

6.2.9.1.3 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Record the indication on the CRT. Verify that OPTX 28V 800 cps 1% 0ph. (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.9.1.4 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.9.1.5 Enter 00010 into K148. Press the ENTER pushbutton.

6.2.9.1.6 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.

6.2.9.2 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 02 flashing
b. R1 = +00000±00007
c. R2 = +00000±00007
d. R3 = +00000±00007
e. IG angle = 000±1 deg.
f. MG angle = 000±1 deg.
g. OG angle = 000±1 deg.

6.2.9.3 Enter VERB 33 and press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 03 flashing
b. R1 = +04500±00007
c. R2 = +04500±00007
d. R3 = +04500±00007
e. IG angle = 045±1 deg.
f. MG angle = 045±1 deg.
g. OG angle = 045±1 deg.

6.2.9.4 Enter VERB 33 and press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing
b. R1 = 00000±00003

6.2.9.30.3.3 Start tape reader. When tape reader stops wait 15 seconds. Verify ISS Warning lamp is out.

6.2.9.30.4 MG FINE FAIL TEST

6.2.9.30.4.1 Start tape reader. When tape reader stops verify R1 = 00607. Wait 15 seconds. Verify NO ATT lamp is lit.

6.2.9.30.4.2 Start tape reader. Within 20 seconds VERB-NOUN lights will flash. Verify ISS Warning lamp is lit and NO ATT lamp is out.

6.2.9.30.4.3 Start tape reader. When tape reader stops wait 15 seconds. Verify ISS Warning lamp is out.

6.2.9.30.5 OG COARSE FAIL TEST

6.2.9.30.5.1 Start tape reader. When tape reader stops verify R1 = 00610. Wait 15 seconds. Verify NO ATT lamp is lit.

6.2.9.30.5.2 Start tape reader. Within 20 seconds VERB-NOUN lights will flash. Verify ISS Warning lamp is lit and NO ATT lamp is out.

6.2.9.30.5.3 Start tape reader. When tape reader stops wait 15 seconds. Verify ISS Warning lamp is out.

6.2.9.30.6 IG COARSE FAIL TEST

6.2.9.30.6.1 Start tape reader. When tape reader stops verify R1 = 00613. Wait 15 seconds. Verify NO ATT lamp is lit.

6.2.9.30.6.2 Start tape reader. Within 20 seconds VERB-NOUN lights will flash. Verify ISS Warning lamp is lit and NO ATT lamp is out.

6.2.9.30.6.3 Start tape reader. When tape reader stops wait 15 seconds. Verify ISS Warning lamp is out.

6.2.9.30.7 MG COARSE FAIL TEST

6.2.9.30.7.1 Start tape reader. When tape reader stops verify R1 = 00616. Wait 15 seconds. Verify NO ATT lamp is lit.

6.2.9.30.7.2 Start tape reader. Within 20 seconds VERB-NOUN lights will flash. Verify ISS Warning lamp is lit and NO ATT lamp is out.

6.2.9.30.7.3 Start tape reader. When tape reader stops wait 15 seconds. Verify ISS Warning lamp is out and NO ATT lamp is lit.

6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.3 Turn On procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that the OPTIX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

a. VERB 41 NOUN 20 ENTR
b. +00000, ENTR
c. +00000, ENTR
d. +00000, ENTR

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

a. OPTICS TEL TRUN to SLAVE TO SXT
b. OPTICS COUPLING to DIRECT
c. OPTICS SPEED to HI
d. OPTICS MODE to MAN

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

a. R1 = +0.00° +0.02°, -0.03° (Shaft Angle)
b. R2 = +0.000° +0.006°, -0.007° (Trunnion Los Angle)

Record the TPAC indications. The Shaft Angle shall be 0.0±0.11 degrees. The Trunnion Angle shall be 0.0±0.22 degrees.

6.2.10.5.1 Enter the following:

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.2 Return the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS TIME TO ZERO TESTS

6.2.10.6 Deleted.

6.2.10.7	Deleted.
6.2.10.8	Deleted.
6.2.10.9	Deleted.
6.2.10.10	Deleted.
6.2.10.11	Deleted.

c. OPTICS SPEED to HI
d. OPTICS MODE to MAN

6.2.11.4 Set up the analog recorders to monitor the following measurements:

a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS ZERO switch to OFF.

RESOLVED MODE PHASING AND IMAGE RATE TEST

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the OPTICS COUPLING switch on the G&N Panel to RSLV and controller speed switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders.

6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45±10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45±10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be +225±10.00 degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the trunnion measurement. The elapsed time shall be +19 to +32 seconds.

CSC AMPLIFIER SHAFT AND TRUNNION DRIVE TEST

6.2.11.12 Set the OPTICS COUPLING switch to DIRECT. Again using the OPTICS CONTROL STICK, drive the optics until R1 = +225.00 and R2 = +10.000. Set the OPTICS COUPLING switch to RSLV.

6.2.11.13 While sighting on the optical target through the SCT eyepiece displace the OPTICS CONTROL STICK fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the OPTICS CONTROL STICK when the target image reaches the edge of the SCT field of view.

6.2.11.14 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.

6.2.12.6.5 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.

6.2.12.6.6 Set the OPTICS TEL TRUN switch to SLAVE to SXT position.

6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.

NOTE: If needed to reduce external light, place a photographer's hood over the optics head and retroreflecting prism.

6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of Step 6.2.12.6.11.

6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the verticle displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).

6.2.12.6.10 Set the OPTICS TEL TRUN switch to 0° position.

6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.

6.2.12.6.12 Remove the Retroreflecting Prism.

6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.

6.2.12.6.14 While sighting into the SCT eyepiece, set the OPTICS TEL TRUN switch to 25 deg. and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25 deg. below the center of the field of view.

6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00° ±1.0°..

6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-097. Set the OPTICS SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.

6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 2 on A23-097. Set the OPTICS SPEED switch to LO as the target is approached.

6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.

6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds set the switch to OFF. Set the OPTICS MODE switch to CMC.

6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.

6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.

6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.

6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.

6.2.12.9 Optics Rate Calibration

6.2.12.9.1 Verify K-START Tape N05C113-K10554-XX on the tape reader to Section 01000. Start Tape Reader.

6.2.12.9.2 When tape reader stops, verify R1 = 01000.

6.2.12.9.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

a. TEL TRUN to SLAVE to SXT
b. OPTICS COUPLING to DIRECT
c. OPTICS SPEED to LO
d. OPTICS MODE to MAN
e. OPTICS ZERO to OFF

6.2.12.9.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set OPTICS speed to LO. Set OPTICS ZERO to OFF.

6.2.12.9.5 Start tape reader (KST-01001).

6.2.12.9.6 Wait approximately 35 seconds after tape reader stops for R1 = 00001. When R1 = 00001 start tape reader.

6.2.12.9.7 When tape reader stops record contents of R1, R2 and R3. R1 is run number. R2 (Trunnion S. F.) shall be between 00221 and 00271. R3 (Shaft S. F.) shall be between 00447 and 00560.

6.2.12.9.8 Start tape reader (KST-01003).

6.2.12.9.9 Wait approximately 35 seconds after tape reader stops for R1 = 00002. When R1 = 00002 start tape reader.

6.2.12.9.10 When tape reader stops record contents of R1, R2 and R3. R1 is run number. R2 (Trunnion S. F.) shall be between 00221 and 00271. R3 (Shaft S. F.) shall be between 00447 and 00560.

6.2.12.9.11 Start tape reader (KST-01005).

6.2.12.9.12 Wait approximately 20 seconds after tape reader stops for R1 = 00003. When R1 = 00003 start tape reader.

6.2.12.9.13 When tape reader stops record contents of R1, R2 and R3. R1 is run number. R2 (Trunnion S. F.) shall be between 00221 and 00271. R3 (Shaft S. F.) shall be between 00447 and 00560.

6.2.13

6.2.12.9.14 Start tape reader (KST-01007).

6.2.12.9.15 Wait approximately 20 seconds after tape reader stops for R1 = 00004. When R1 = 00004 start tape reader.

6.2.12.9.16 When tape reader stops record contents of R1, R2 and R3. R1 is run number. R2 (Trunnion S. F.) shall be between 00221 and 00271. R3 (Shaft S. F.) shall be between 00447 and 00560.

6.2.12.9.17 Start tape reader (KST-01011).

6.2.12.9.18 Wait approximately 15 seconds after tape reader stops for R1 = 00005. When R1 = 00005 start tape reader.

6.2.12.9.19 When tape reader stops record contents of R1, R2 and R3. R1 is run number. R2 (Trunnion S. F.) shall be between 00221 and 00271. R3 (Shaft S. F.) shall be between 00447 and 00560.

6.2.12.9.20 Start tape reader (KST-01013).

6.2.12.9.21 Wait approximately 15 seconds after tape reader stops for R1 = 00006. When R1 = 00006 start tape reader.

6.2.12.9.22 When tape reader stops record contents of R1, R2 and R3. R1 is run number. R2 (Trunnion S. F.) shall be between 00221 and 00271. R3 (Shaft S. F.) shall be between 00447 and 00560.

6.2.12.9.23 Start tape reader. When tape reader stops verify R1 = 01015. Test is terminated.

6.2.13 Optics Slew Rate Tests

NOTE: Perform Master Initialization before proceeding.

6.2.13.1 Optics Hand Controller Slew Rate Test

6.2.13.1.1 Place K-START Tape N05C113-K10554-XX on the tape reader to Section 00700. Start Tape Reader.

6.2.13.1.2 When Tape Reader stops, verify R1 = 00700.

6.2.13.1.3 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.13.1.4 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.

a. TEL TRUN to SLAVE to SXT
b. OPTICS COUPLING to DIRECT
c. OPTICS SPEED to HI
d. OPTICS MODE to MAN
e. OPTICS ZERO to OFF

POSITIVE SHAFT SLEW RATE - HI SPEED

6.2.13.1.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Return OPTICS SPEED to HI.

NOTE: Read and understand the next three steps before proceeding.

6.2.13.1.6 While slewing the optics, record the following signals: SXT SHAFT SERVO error (CG 3117), SXT SHAFT TACH (CG 3140), and SCT SHAFT TACH (CG 3160). CG 3117 shall be less than -0.25 VRMS. CG 3140 shall be 3.3±1.3 VRMS. CG 3160 shall be -3.3±1.3 VRMS.

6.2.13.1.7 Start tape reader. When the tape reader stops verify R1 = 00701.

6.2.13.1.8 Set the OPTICS ZERO switch on the G&N Indicator Control panel to OFF. Immediately push and hold the OPTICS CONTROL STICK to its right limit until the shaft on TPAC reading indicates 175 degrees. Release the Control Stick. VERB 06 NOUN 66 shall be displayed flashing on DSKY. Record the R1 and R2 display (R1 is whole part and R2 is fractional part (Deg/sec)). Value recorded shall be 19.5±3.9 deg/sec.

POSITIVE TRUNNION SLEW RATE - HI SPEED

NOTE: Read and understand the next two steps before proceeding.

6.2.13.1.9 While slewing the optics after the tape load, record the following signals: SXT TRUN SERVO error (CG 3118), SXT TRUN TACH (CG 3150), and SCT TRUN TACH (CG 3170). CG 3118 shall be less than -0.25 VRMS. CG 3150 shall be 3.3±1.3 VRMS. CG 3170 shall be -0.85±0.35 VRMS.

6.2.13.1.10 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED drive the Optics Trunnion to 0±1° as indicated on the TPAC. Return OPTICS SPEED to HI. Immediately start the tape reader. When tape reader stops verify R1 = 00702. Within 10 seconds push and hold the OPTICS CONTROL STICK to its upper limit until the Trunnion TPAC reading indicates 150 degrees. Release the OPTICS CONTROL STICK. VERB 06 NOUN 66 shall be displayed flashing on the DSKY. Record R1 and R2 display (R1 as whole part and R2 as fractional part (Deg/sec)). Value recorded shall be 10±2 deg/sec.

6.2.13.2 OPTICS HAND CONTROLLER DRIFT RATE CHECK - LO SPEED

6.2.13.2.1 On K-148, enter VERB 06 NOUN 56 ENTER. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF.

6.2.13.2.2 Press and release MARK pushbutton. Approximately 60 seconds after the first MARK, again press and release MARK pushbutton. Verify KEY RELEASE is flashing. Press KEY RELEASE pushbutton and record data in R1, R2 and R3 within 2 seconds. When DSKY display changes, again record R1, R2 and R3. The data display is in the following form:

a. R1 = ±XXX.XX (Shaft Angle in Degrees)
b. R2 = ±XX.XXX (Trunnion Angle in Degrees)
c. R3 = +XXX.XX (Time in Seconds)

6.2.13.2.3 Perform the following calculations (first display minus second display):

a. Difference between R1 displays = ______ (Δ shaft angle)
b. Difference between R2 displays = ______ (Δ trunnion angles)
c. Difference between R3 displays = ______ (Δ time)
d. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$ = _____ deg/sec (shaft drift rate)
shall be less than 0.0333 deg/sec.
e. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}}$ = _____ deg/sec (trunnion drift rate)
shall be less than 0.0167 deg/sec.

[illegible]

6.2.14 Stabilization Loop Step Response Test

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.3 Verify K-START Tape N05C113-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00400.

6.2.14.3.1 Start the Tape Reader.

6.2.14.3.2 When the tape reader stops, press ERR RSET pushbutton and verify the following:

(a) R1 = 00400

6.2.16.7.59 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.60 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 [.707 (NBDY-NBDX) + .5 (ADIAY-ADIAX) + .5 ADSRA X] Position +00010.

6.2.16.7.61 Test Termination

6.2.16.7.62 Verify K-START Tape N05C113-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00400.

6.2.16.7.63 Start the Tape Reader.

6.2.16.7.64 When the Tape Reader stops, verify the following:

(a) R1 = 00400.
(b) CMC Activity light ON.
(c) On CRT, the two most significant octal digits of CH77 incrementing.
(d) The NO ATT light ON.

6.2.16.9 Deleted.

6.2.17.60 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes, R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc-seconds (R1 = whole, R2 = fractional). (See Table II for PIPA displayed). Record R1 and R2.

6.2.17.61 Enter VERB 34 ENTER into the DSKY to terminate the test. Wait 5 seconds.

6.2.17.62 Repeat Steps 6.2.17.33 through 6.2.17.61, substituting numbers as follows:

00000 in Step 6.2.17.35.c
00001 in Step 6.2.17.35.e

+00000 in Step 6.2.17.44.b
+89999 in Step 6.2.17.44.c

6.2.17.63 Verify K-START Tape N05C113-K10554-XX CSM S/C TEST TAPE is on the K-START Tape Reader at Section 00400.

6.2.17.63.1 Start the Tape Reader.

6.2.17.63.2 When the tape reader stops, verify the following:

(a) R1 = 00400.
(b) CMC Activity light ON
(c) On CRT, the two most significant octal digits of CH77 incrementing.
(d) The NO ATT light ON

TABLE II

Display Conditions at Test Completion

Position	SM Orientation			Horizontal Misalignment Component	
	X_{XM}	Y_{SM}	Z_{SM}	6.2.17.29 & .59	6.2.17.30 & .60
1	UP	SW	SE	Y_{SM}	Z_{SM}
2	SE	SW	DN	X_{SM}	Y_{SM}
4	DN	SE	SW	Y_{SM}	Z_{SM}
5	SW	SE	UP	X_{SM}	Y_{SM}

6.2.17.64 Set the G/N POWER-OPTICS switch on the LEM Lighting Control Panel to OFF.

6.2.17.65 Calculations

6.2.17.65.1
a. Y_{SM} misalignment = ( ) $\underline{R1 \cdot R2}$
b. Z_{SM} misalignment = ( ) $\underline{R1 \cdot R2}$

6.2.20.3 TVC Test

6.2.20.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N interface.

6.2.20.3.2 Set the OPTICS MODE selector on the Indicator Control panel to MAN. Set the OPTICS ZERO switch to OFF.

6.2.20.3.3 Insert in K148

a. VERB 33, ENTER

6.2.20.3.4 Observe on CRT

a.	V 01	N 10	Flashing
b.	R1		X7373
c.	R3		00030

6.2.20.3.5 Insert in K148

a. V 33 ENTER

6.2.20.3.6 Observe on CRT

a.	V 01	NOUN 10	Flashing
b.	R1		37777
c.	R3		00031

6.2.20.3.7 Insert in K148

a. V 33 ENTER

6.2.20.3.8 Observe on CRT

a.	V 06	N 02	Flashing
b.	R1		+00385
c.	R2		-00385
d.	R3		+00003

6.2.20.3.9 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	+16.85 +10.12±1.00 VRMS
b.	CG 3721	SHAFT CDU DAC OUTPUT	-16.85 -10.12±1.00 VRMS

6.2.20.3.10 Insert in K148

a. VERB 33, ENTER

6.2.20.3.11 Observe on CRT

a. V 06 N 02 Flashing
b. R1 +00384
c. R2 -00384
d. R3 +00003
e. NO ATT OFF

6.2.20.3.12 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +10.12±1.00 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT -10.12±1.00 VRMS

6.2.20.3.13 Insert in K148

a. VERB 33, ENTER

6.2.20.3.14 Observe on CRT

a. V 06 N 02 Flashing
b. R1 +00160
c. R2 -00160
d. R3 +00003

6.2.20.3.15 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +4.22±0.42 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT -4.22±0.42 VRMS

6.2.20.3.16 Insert in K148

a. VERB 33, ENTER

6.2.20.3.17 Observe on CRT

a. V 06 N 02 Flashing
b. R1 +00135
c. R2 -00135
d. R3 +00003

6.2.20.3.18 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +3.56±0.36 VRMS
b. CG 3721 SHAFT CDU DAC OUTPUT -3.56±0.36 VRMS

6.2.20.3.19 Insert in K148

a. VERB 33, ENTER

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 2219	1	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2220	1	IG CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 2221	1	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS at null	0.29%
CG 2249	1	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2250	1	MG CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 2251	1	MG CDU COARSE ERROR	0.0 ± 0.68 VRMS at null	0.29%
CG 2279	1	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2280	1	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	0.29%
CG 2281	1	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	0.29%
CG 2300	1	PIPA TEMPERATURE	130.5 ± 1.5°F Operate Mode	2%
CG 3011	2	TRUNNION CDU FINE ERROR	0.0 ± 0.07 VRMS at null	1.0%
CG 3021	1	SHAFT CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 3117	1	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	1.1%
CG 3118	1	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	1.1%
CG 3140	1	SXT SHAFT TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3145	1	SXT SHAFT MTR CONTROL WINDING	+0.50 to +4.00 VRMS Med Rate	1.1%
CG 3150	1	SXT TRUNNION TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3155	1	SXT TRUNNION MTR CONTROL WINDING	+0.25 to +2.00 VRMS Med Rate	1.1%
CG 3160	1	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3170	1	SCT TRUNNION TACH O/P	0.85 ± 0.35 VRMS at Hi Rate	1.1%
CG 3721	1	SHAFT CDU DAC O/P	10.12 ± 1.00 VRMS at 17°	1%
CG 3722	2	TRUNNION CDU DAC O/P	10.12 ± 1.00 VRMS at 17°	1%
CG 4300	2	CMC TEMP	87.5 ± 42.5°F	0.0%
CG 6020	1	PIPA CAL MODULE TEMP	72.5 ± 27.5°F	0.23%
CG 6021	1	IMU 800 cps 5% TEMP (PSA)	90 ± 30°F	0.23%
CG 2301	1	IRIG TEMPERATURE	135 ± 2.5°F in Operate	2%
CG 1021	1	+14V CMC SUPPLY NOISE RMS	0.2 VRMS max	0%
CG 1031	1	+4 CMC SUPPLY NOISE RMS	0.2 VRMS max	0%

PSAAM OUTPUT is the source of Link 1 signals.
SCA OUTPUT is the source of Link 2 signals.

APOLLO G&N Specification
ND1002325 REV-AD
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POST INSTALLATION CHECKOUT PROCESS
SPECIFICATION FOR THE APOLLO GUIDANCE
AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				DE	NASA
5/25/70	AB	38167	15-38, 42, 50-56, 59-61, 64, 67,	EA	MDH
			71, 85, 91, 92, 105, 113, 121, 122,		
			126, 130-172; was 172 pages,		
			now 169 pages. JFD/AC		
9/25/70	AC	38248	16, 17, 24, 26, 33, 35-37, 40-42, 46,	EA	MDH
			50, 51, 56, 64, 67, 74, 76-169; was		
			169 pages, now 171 pages. JFD/AC		
2/4/71	AD	38344	16, 33, 49-51, 54, 56, 64, 67, 70, 81,	EA	MDH
			84, 86-89, 93, 107, 123. JFD/AC		

This specification consists of page 1 to 171 including Appendix I, pages 146-147, Addendum I, pages 148-168, Addendum II, page 169-170 **and Addendum III, page 171.**

APPROVALS	Not required per CCA-497-0274 **NASA/MSC**	**MIT/IL**	R. D. Petryk	D.A. Ziemer
			DE	

6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.

6.2.12.9 Optics Rate Calibration

6.2.12.9.1 Verify K-START Tape N05C114-K10554-XX on the tape reader to Section 01000. Start Tape Reader.

6.2.12.9.2 When tape reader stops, verify R1 = 01000.

6.2.12.9.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

a. TEL TRUN to SLAVE to SXT
b. OPTICS COUPLING to DIRECT
c. OPTICS SPEED to LO
d. OPTICS MODE to MAN
e. OPTICS ZERO to OFF

6.2.12.9.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set OPTICS speed to LO. Set OPTICS ZERO to OFF.

6.2.12.9.5 Start tape reader (KST-01001).

6.2.12.9.6 Wait approximately 35 seconds after tape reader stops for R1 = 00001. When R1 = 00001 start tape reader.

6.2.12.9.7 When tape reader stops record contents of R1, R2 and R3. R1 is run number. R2 (Trunnion S. F.) shall be between 00221 and 00271. R3 (Shaft S. F.) shall be between 00447 and 00567.

6.2.12.9.8 Start tape reader (KST-01003).

6.2.12.9.9 Wait approximately 35 seconds after tape reader stops for R1 = 00002. When R1 = 00002 start tape reader.

6.2.12.9.10 When tape reader stops record contents of R1, R2 and R3. R1 is run number. R2 (Trunnion S. F.) shall be between 00221 and 00271. R3 (Shaft S. F.) shall be between 00447 and 00567.

6.2.12.9.11 Start tape reader (KST-01005).

APOLLO G&N Specification
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POST INSTALLATION CHECKOUT PROCESS SPECIFICATION FOR THE APOLLO GUIDANCE AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
5/9/69	U	37563	90, 93, 128-131	EA	RJJ
10/1/69	V	37863	25, 26	EA	MDH
10/15/69	W	37886	74-167, was 167 pages, now	EA	MDH
			168 pages.		
11/3/69	Y	37911	11, 12, 74-105, 107; was 168	EA	MDH
			pages, now 172 pages JFD/AC		

APPROVALS	Not required per CCA-497-0274 NASA/MSC	MIT/IL	R. D. Petryk D.A. Ziemer AC

6.2.9.27.2.1 Perform the following on the DSKY.

VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR

Observe: Tracker fail and PGNS warning lamps on.

6.2.9.27.2.2 Perform the following on the DSKY.

VERB 21 NOUN 10 ENTR
00012 ENTR
00000 ENTR

Depress Error Reset and observe the Tracker fail and PGNS warning lamps off.

6.2.9.27.3 Using the Optics Hand Controller, drive the Optics Shaft until the shaft TPAC indicates 0.00 degree and drive the Optics Trunnion until the trunnion TPAC indicates 0.75 degree.

6.2.9.27.3.1 Perform the following on the DSKY.

VERB 21 NOUN 10 ENTR
00012 ENTR
00001 ENTR

Observe: Tracker fail and PGNS warning lamps on.

6.2.9.27.3.2 Perform the following on the DSKY.

VERB 21 NOUN 10 ENTR
00012 ENTR
00000 ENTR

Depress Error Reset.

6.2.9.28 Computer Manual Mode Optics Drive

NOTE: Perform the following procedure only if GNIC panel, P/N 2021290-51 is installed in the spacecraft.

6.2.9.28.1 Place the OPTICS ZERO switch on the Indicator Control Panel to ZERO and the OPTICS MODE switch to CMC.

6.2.9.28.1.1 Wait 20 seconds and then place the OPTICS ZERO switch on the Indicator Control Panel to OFF.

6.2.9.28.1.2 Perform the following on the DSKY:

VERB 41 NOUN 55 ENTR
+00000 ENTR
+00000 ENTR

6.2.9.28.2 Place the OPTICS MODE switch on the Indicator Control Panel to MANUAL. Perform the following step within 1 minute.

6.2.9.28.4.3 Set the OPTICS Hand Controller full up. Record R2 and relase the Hand Controller.

6.2.9.28.4.4 Set the OPTICS Hand Controller full down. Record R2 and release the Hand Controller.

6.2.9.28.4.5 Perform the following calculations for Trunnion.

Subtract the value of R2 from Step 6.2.9.28.2.6 ($R2_{26}$) from the value of R2 recorded in Step 6.2.9.28.4.3 ($R2_{43}$).

Verify $R2_{43} - R2_{26} = 0.40$ deg ±0.12 deg.

Subtract the value of R2 from Step 6.2.9.28.2.6 ($R2_{26}$) from the value of R2 recorded in Step 6.2.9.28.4.4 ($R2_{44}$).

Verify $R2_{44} - R2_{26} = -0.40$ deg ±0.12 deg.

6.2.9.28.5 Perform the following on the DSKY:

VERB 21 NOUN 10 ENTR
00012 ENTR
00000 ENTR

6.2.9.29 Set the G/N Power-Optics switch on the LEB lighting control panel to OFF.

6.2.10 Zero Optics Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 Turn On procedure before proceeding.

INITIALIZATION

6.2.10.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 ±3.0 VDC. Verify that the OPTIX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.10.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

a. VERB 41 NOUN 20 ENTR
b. +00000, ENTR
c. +00000, ENTR
d. +00000, ENTR

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

a. OPTICS TEL TRUN to SLAVE TO SXT
b. OPTICS COUPLING to DIRECT

6.2.10.3 (Cont)
c. OPTICS SPEED to HI
d. OPTICS MODE to MAN

OPTICS ZERO MODE TEST

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K-148. Press the ENTER pushbutton.

6.2.10.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the DSKY.

a. R1 = +0.00° +0.02°, -0.03° (Shaft Angle)
b. R2 = +0.000° +0.006°, -0.007° (Trunnion Los Angle)

Record the TPAC indications. The Shaft Angle shall be 0.0±0.11 degrees. The Trunnion Angle shall be 0.0±0.22 degrees.

6.2.10.5.1 Enter the following:

VERB 01 NOUN 10, ENTER
00033, ENTER
Verify R1 = XXX6X

6.2.10.5.2 Return the OPTICS ZERO switch to OFF. Set the OPTICS MODE switch to CMC. Enter the following:

ENTER
00033, ENTER
Verify R1 = XXX5X

6.2.10.5.3 Set the OPTICS MODE switch to MAN. Press the KEY REL pushbutton on the DSKY.

OPTICS TIME TO ZERO TESTS

6.2.10.6 Deleted.

6.2.10.7 Deleted.

6.2.10.8 Deleted.

6.2.10.9 Deleted.

6.2.10.10 Deleted.

6.2.10.11 Deleted.

6.2.10.12 Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF. Set the G&N Power Optics Switch on the LEB Lighting Control Panel to OFF.

OPTICS BACKUP MODE TEST

6.2.10.13 Insert the inflight tool (V36601405) into the Trunnion Tool input and engage drive mechanism (button out). Verify that the trunnion turns by viewing the movement through the SCT eyepiece while turning the tool until the TPAC reads +5 deg. Remove the tool from the trunnion tool input.

6.2.10.14 Insert the inflight tool (V36601405) into the Shaft Tool input and engage the drive mechanism (button out). Verify that the Shaft turns by viewing the movement through the SCT eyepiece while turning the tool so that the shaft moves through an angle from 0° to +3° to 0 as indicated on the shaft TPAC. Disengage the shaft drive mechanism (button in) and remove the tool.

6.2.10.15 Insert the inflight tool (V36601405) into the Trunnion Tool input. Verify that the Trunnion turns by viewing the movement through the SCT eyepiece while turning the tool so that the trunnion moves from +5° to -5° and back to zero as indicated on the Trunnion TPAC. Disengage the trunnion drive mechanism (button in) and remove the tool.

6.2.11 OPTICS Coordinate Transformation Control Test

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

INITIALIZATION

6.2.11.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±0.3 VDC. Verify that the OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5% - 90 ph (CG 1212) are not flashing on the CRT.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

a. OPTICS TEL TRUN to SLAVE to SXT
b. OPTICS COUPLING to DIRECT

c. OPTICS SPEED to HI
d. OPTICS MODE to MAN

6.2.11.4 Set up the analog recorders to monitor the following measurements:

a. CG 3170 SCT Trunnion Tachometer Output

6.2.11.5 Enter the following into the K-Start to monitor the OPTICS CDU's.

VERB 16 NOUN 55, press ENTER

6.2.11.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Panel to ZERO. Wait 15 seconds. Return the OPTICS ZERO switch to OFF.

RESOLVED MODE PHASING AND IMAGE RATE TEST

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2 = +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the OPTICS COUPLING switch on the G&N Panel to RSLV and controller speed switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT retical pattern, then start the analog recorders.

6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45±10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45±10 deg. When target leaves the SCT upper right field of view press MARK pushbutton and immediately record the shaft angle as displayed on R1 of the DSKY. The recorded shaft angle shall be +225±10.00 degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the trunnion measurement. The elapsed time shall be +19 to +32 seconds.

CSC AMPLIFIER SHAFT AND TRUNNION DRIVE TEST

6.2.11.12 Set the OPTICS COUPLING switch to DIRECT. Again using the OPTICS CONTROL STICK, drive the optics until R1 = +225.00 and R2 = +10.000. Set the OPTICS COUPLING switch to RSLV.

6.2.11.13 While sighting on the optical target through the SCT eyepiece displace the OPTICS CONTROL STICK fully to the right. Verify that the target image appears to move in a straight line horizontally to the right and release the OPTICS CONTROL STICK when the target image reaches the edge of the SCT field of view.

6.2.11.14 Enter VERB 34 in the DSKY.
Press the ENTER pushbutton.

6.2.11.15 Set the OPTICS COUPLING switch on the G&N Panel to DIRECT. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion Slaved to SXT). Set the OPTICS ZERO switch to ZERO.

NOTE: If Optics testing will continue, set the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set Tracker switch to OFF. Verify the following:

a. +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8±3 VDC. Record the indication on the CRT.

b. CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.

c. CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.2 Enter the following sequence into the K-Start.

a. VERB 41, NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.12.3 Insure that Optics Control switches on the G&N Indicator Control Panel are set as follows:

a. OPTICS ZERO to OFF
b. OPTICS MODE to MAN
c. OPTICS SPEED to LO
d. OPTICS COUPLING to DIRECT
e. OPTICS TEL TRUN to SLAVE to SXT

6.2.12.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting. carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.

6.2.12.5 Resolution Checks

6.2.12.5.1 Sight through the SXT eyepiece. Using the OPTICS CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.

6.2.12.5.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc-seconds at the center of the field of view.

6.2.12.5.3 Repeat 6.2.12.5.1 and 6.2.12.5.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc-minutes at the center of the field of view.

6.2.12.6 Slave Telescope Mode Checks

6.2.12.6.1 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.6.2 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the Control Indicator Panel to ZERO. Wait 15 seconds

6.2.12.6.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ±0.11 degree or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ±0.22 degree or less.

6.2.12.6.4 Place the OPTICS ZERO switch to OFF. Using the OPTICS CONTROL STICK drive the SXT Shaft and Trunnion CDU's until R1 = +035.00±0.10 degree and R2 = 35.000±0.100 degree, setting the CONTROLLER SPEED switch to LO as the angles are approached. Press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles as indicated by the TPAC. Record R1 and R2. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ±0.11 deg or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ±0.22 deg or less.

6.2.12.6.5 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.

6.2.12.6.6 Set the OPTICS TEL TRUN switch to SLAVE to SXT position.

6.2.12.6.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light.

NOTE: If needed to reduce external light, place a photographer's hood over the optics head and retroreflecting prism.

6.2.12.6.8 Sight through the SCT eyepiece and provide direction to personnel outside spacecraft for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT LLOS and SCT LOS such that the illumination from the back-light filament is clearly visible at the center of the field of view. Prism must be held in this alignment position until completion of Step 6.2.12.6.11.

6.2.12.6.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Note the verticle displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement, expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. For instance, the outer ends of the SXT reticle lines are 6% from center. Displacement shall be less than 50% (bar must be closer to center than to edge of field of view).

6.2.12.6.10 Set the OPTICS TEL TRUN switch to 0° position.

6.2.12.6.11 Again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.12.6.9. Place the OPTICS MODE switch to MAN and observe the vertical displacement of the SCT horizontal reticle line from the center of the SXT reticle. Make an estimate of this displacement expressed as a percentage of the total distance from SXT reticle center to edge of field of view. Record, noting direction above or below center. Displacement shall be less than 50%.

6.2.12.6.12 Remove the Retroreflecting Prism.

6.2.12.6.13 Replace the Portable Light in the adapter on the SXT eyepiece.

6.2.12.6.14 While sighting into the SCT eyepiece, set the OPTICS TEL TRUN switch to 25 deg. and observe that the resolution pattern mounted outside the spacecraft appears to move downward from the center of the field of view to the zero reticle marking that is 25 deg. below the center of the field of view.

6.2.12.6.15 Record the TPAC Trunnion Angle. It shall be 25.00° ±1.0°.

6.2.12.6.16 Set the OPTICS TEL TRUN switch to SLAVE TO SXT. Set the OPTICS ZERO switch to OFF.

6.2.12.7 SXT Parallelism Tests

6.2.12.7.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to +15.000±2 degree as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00±0.10 degree as indicated by R1 on the DSKY.

6.2.12.7.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.

6.2.12.7.3 Repeat 6.2.12.7.2 twice. Calculate and record the average of the three autocollimator readings.

6.2.12.7.4 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO.

6.2.12.7.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.

6.2.12.7.6 Repeat 6.2.12.7.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.7.3 by more than 10 arc-seconds.

6.2.12.7.7 Deleted.

6.2.12.7.8 Deleted.

6.2.12.7.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug.

NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12.8 Shaft and Trunnion Positional Accuracy Checks

6.2.12.8.1 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds, return the selector to OFF.

6.2.12.8.2 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.3 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 1 on the G&N Installation Fixture Model No. A23-097. Set the OPTICS SPEED switch to LO as the target is approached. When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.

6.2.12.8.4 Sight through the SXT. Using the control stick align the SXT SLOS with optical target No. 2 on A23-097. Set the OPTICS SPEED switch to LO as the target is approached.

6.2.12.8.5 When the target star is centered in the SXT reticle, press the MARK pushbutton and simultaneously record the Shaft and Trunnion angles from the TPAC. Then record the value of R1 and R2 displayed on the CRT.

6.2.12.8.6 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds set the switch to OFF. Set the OPTICS MODE switch to CMC.

6.2.12.8.7 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.8 Enter the value recorded from R1 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.9 Enter the value recorded from R2 in 6.2.12.8.3 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.10 Sight through the SXT. The SLOS should be centered on Optical Target No. 1 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.3 shall be less than 0.25 degrees. Record the difference.

6.2.12.8.11 Enter VERB 41 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.12 Enter the value recorded from R1 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.13 Enter the value recorded from R2 in 6.2.12.8.5 into the K-Start. Press the ENTER pushbutton.

6.2.12.8.14 Sight through the SXT. The SLOS should be centered on Optical Target No. 2 (within a circle defined by the outer ends of the SXT reticle lines). Record the Shaft and Trunnion Angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.8.5 shall be less than 0.25 degrees. Record the difference.

6.2.12.8.15 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. After 15 seconds return the switch to OFF.

6.2.12.8.16 Enter VERB 41 NOUN 20 into the K-Start. Press the ENTER pushbutton. Enter +00000 into the K-Start 3 times. Press the ENTER pushbutton after each entry.

6.2.13 Optics Slew Rate Test

NOTE: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.13.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0±3.0 VDC. Verify that OPTX 28V 800 cps 1% zero (CG 1211) and OPTX 28V 800 cps 5%-90 ph (CG 1212) are not flashing on the CRT.

6.2.13.2 Enter the following sequence into K-148. Press the ENTER pushbutton after each entry.

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.13.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.

a. TEL TRUN to SLAVE to SXT
b. OPTICS COUPLING to DIRECT
c. OPTICS SPEED to HI
d. OPTICS MODE to MAN

6.2.13.4 Monitor MARK COMMAND by entering VERB 06 NOUN 56 into K-148. Press the ENTER pushbutton.

TRUNNION SLEW RATE - HI SPEED

6.2.13.5 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees to zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch on the G&N Indicator Control Panel to OFF.

NOTE: Read and understand step 6.2.13.6 before proceeding. Do not hold Control Stick at upper limit more than 10 seconds, or exceed a trunnion angle of 85 degrees.

6.2.13.6 While slewing the optics, record the following signals: SXT TRUN SERVO error (CG 3118), SXT TRUN TACH (CG 3150), and SCT TRUN TACH (CG 3170). CG 3118 shall be between -0.25 and -2.0 VRMS. ~~CG 3150 shall be between -0.25 and -2.0 VRMS.~~ CG 3150 shall be 3.3±1.3 VRMS. CG 3170 shall be -0.85±0.35 VRMS. [illegible]

6.2.13.6 (Continued) Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds.

(before display changes). . The data displayed is in the following form:

a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the value of R2 and R3.

6.2.13.7 Perform the following calculations:

NOTE: In performing calculation b. below, and in similar calculations throughout this test procedure, the following shall be noted and taken into account. It is possible that the second R3 reading may be smaller than the first reading. If so, add an overflow time value of 163.84 sec to the second reading and then subtract the first reading, in order to obtain Δ time as the difference of the two R3 readings.

a. Difference between R2 displays = ________ (Δ trun. angle)
b. Difference between R3 displays = ________ (Δ time)
c. $\frac{\Delta \text{ trun. angle}}{\Delta \text{ time}} = \_ . \_$ deg/sec

The trunnion slew rate shall be 10±2 deg/sec.

SHAFT SLEW RATE - HI SPEED.

6.2.13.8 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand step 6.2.13.9 before proceeding. Do not hold Control Stick at right limit for more than 10 seconds, or exceed a shaft angle of 250 degrees.

6.2.13.9 While slewing the optics, record the following signals: SXT SHAFT SERVO error (CG 3117), SXT SHAFT TACH (CG 3140), and SCT SHAFT TACH (CG3160). CG 3117 shall be between -0.2 and -2.0 VRMS. CG 3140 shall be 3.3±1.3 VRMS. CG 3160 shall be -3.3±1.3 VRMS. Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form:

a. R1 = ±XXX.XX (Shaft angles in deg.)
b. R3 = +XXX.XX (Time in seconds.)

After the display has changed, again record the values of R1 and R3.

6.2.13.10 Perform the following calculations:

a. Difference between R1 displays = ___.__ (Δ shaft angle)
b. Difference between R3 displays = ___.__ (Δ time)
c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$ = ___._ deg/sec

The Shaft Slew Rate shall be 19.5±3.9 deg/sec
TRUNNION SLEW RATE - MED SPEED

6.2.13.11 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to MED. Monitor MARK command by entering VERB 06 NOUN 56 in K148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.12 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155), SXT TRUN SERVO error

6.2.13.12 Record the SXT TRUN MTR control winding (CG 3155) signal on the CRT while slewing the optics. CG 3155 shall be +0.25 to +2.00 VRMS. Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.13 Perform the following calculations:

a. Difference between R2 displays = __.___ (Δ trunnion angle)
b. Difference between R3 displays = ___.__ (Δ time)
c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}}$ = _.__ deg/sec

The Trunnion Slew Rate shall be 1.0±0.2 deg/sec.

SHAFT SLEW RATE - MED SPEED

6.2.13.14 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to MAN. Monitor MARK Command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.15 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.15 Record the SXT SHAFT MTR control winding (CG 3145) signal on the CRT while slewing the optics. CG 3145 shall be +0.50 to +4.0 VRMS. Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 seconds (before display changes). The data displayed is in the following form:

a. R1 = ±XXX.XX (Shaft angles in deg)
b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.16 Perform the following calculations:

a. Difference between R1 displays = ___.__ (Δ shaft angle)
b. Difference between R3 displays = ___.__ (Δ time)
c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}} = \_.\_\_$ deg/sec

The Shaft Slew Rate shall be 2.0±0.4 deg/sec.

TRUNNION SLEW RATE - LO SPEED

6.2.13.17 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Set the OPTICS SPEED switch to LO. Monitor MARK command by entering the VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.18 before proceeding. Do not hold control stick at upper limit for more than 30 seconds.

6.2.13.18 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R2 and R3 within 2 sec (before display changes). The data displayed is in the following form:

a. R2 = ±XX.XXX (Trunnion LOS angle in deg)
b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R2 and R3.

6.2.13.19 Perform the following calculations:

a. Difference between R2 displays = __ . ___ (Δ trunnion angle)
b. Difference between R3 displays = ___ . __ (Δ time)
c. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}}$ = _ . __ deg/sec.

The Trunnion Slew Rate shall be 0.10±0.02 deg/sec.

SHAFT SLEW RATE - LO SPEED

6.2.13.20 Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF. Monitor MARK command by entering VERB 06 NOUN 56 in K-148. Press the ENTER pushbutton.

NOTE: Read and understand 6.2.13.21 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.21 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton.
Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and verify that the KEY RELEASE lamp is lighted. Press the KEY RELEASE and immediately record the display in R1 and R3 within 2 sec (before display changes). The data displayed is in the following form:

a. R1 = ±XXX.XX (Shaft angle in deg)
b. R3 = +XXX.XX (Time in seconds)

After the display has changed, again record the values of R1 and R3.

6.2.13.22 Perform the following calculations:

a. Difference between R1 displays = ___ . __ (Δ shaft angle)
b. Difference between R3 displays = ___ . __ (Δ time)
c. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$ = _ . __ deg/sec

The Shaft Slew Rate shall be 0.20±0.04 deg/sec.

OPTICS HAND CONTROLLER DRIFT RATE CHECK - LO SPEED

6.2.13.23 On K-148, enter VERB 06 NOUN 56 ENTER. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion slaved to SXT). Set the OPTICS ZERO switch to ZERO. Wait 15 seconds. Set the OPTICS ZERO switch to OFF.

6.2.13.24 Press and release MARK pushbutton. Approximately 60 seconds after the first MARK, again press and release MARK pushbutton. Verify KEY RELEASE is flashing. Press KEY RELEASE pushbutton and record data in R1, R2 and R3 within 2 seconds. When DSKY display changes, again record R1, R2 and R3. The data display is in the following form:

a. R1 = ±XXX.XX (Shaft Angle in Degrees)
b. R2 = ±XX.XXX (Trunnion Angle in Degrees)
c. R3 = +XXX.XX (Time in Seconds)

6.2.13.25 Perform the following calculations (first display minus second display):

a. Difference between R1 displays = ______ (Δ shaft angle)
b. Difference between R2 displays = ______ (Δ trunnion angles)
c. Difference between R3 displays = ______ (Δ time)
d. $\frac{\Delta \text{ shaft angle}}{\Delta \text{ time}}$ = ______ deg/sec (shaft drift rate)
shall be less than 0.0333 deg/sec.
e. $\frac{\Delta \text{ trunnion angle}}{\Delta \text{ time}}$ = ______ deg/sec (trunnion drift rate)
shall be less than 0.0167 deg/sec.

6.2.13.26 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.14 Stabilization Loop Step Response Test

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.

6.2.14.4 Inner Gimbal Response Test

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.

6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 Deleted. [illegible] into R154. Verify and execute to apply +28 VDC ACE ENABLE to the PSAAM.

6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the IG stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on theLEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ±5 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.

6.2.14.5 Middle Gimbal Response Test

6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.

CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.

6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the stab loop response time by measuring the time interval between removing the step input and the settling of the error signals to a value equal to ±5 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals shall be three.

6.2.14.6 Outer Gimbal Response Test

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up CG 2177 OCA SERVO ERROR on 4A1-A3-CH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step input and the settling of the error signal to a value equal to ±5 percent of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be five.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

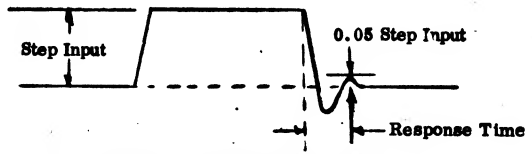

Figure 1. Typical Step Input Response

6.2.14.7.5 Deleted. 0 into R154. Verify and execute to remove +28 VDC ACE ENABLE.

6.2.15 IRIG Scale Factor Test

6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.

6.2.15.3 Set up the Analog Recorders to monitor the following signals:

a. CG 2117 IG SERVO ERROR
b. CG 2147 MG SERVO ERROR
c. CG 2177 OG SERVO ERROR
d. CG 2120 IG TM CURRENT
e. CG 2150 MG TM CURRENT
f. CG 2180 OG TM CURRENT

6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.

6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton. Program 07 shall be displayed.

6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:

R1 = ±xxxxx (some Nav. Base azimuth)
R2 = ±xxxxx (some test site latitude; see Table I)

6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:

a. To correct R1, on the K-start enter VERB 21, press ENTER pushbutton, ±xxx.xx, press ENTER (±xxx.xx is correct nav. base azimuth).

b. To correct R2, on the K-start enter VERB 22, press ENTER pushbutton, ±xx.xxx, press ENTER (obtain correct site latitude from Table I).

Verify values in R1 and R2 are correct.

Table I

Site	Latitude
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.15.8 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00001 ENTR
NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.8.

6.2.15.9 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+X IRIG Scale Factor error in part per million, Position +00001).

6.2.15.10 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00002 ENTR
NOTE: If PROG lamp changes from 07 to 00 during next step or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.10.

6.2.15.11 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Y IRIG Scale Factor error in parts per million Position +00002).

6.2.15.12 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
+00003 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.12.

6.2.15.13 In approximately 160 seconds VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Z IRIG Scale Factor error in parts per million, position +00003).

6.2.15.14 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00001 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is on, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.14.

6.2.15.15 In approximately 160 seconds, VERB 05 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-X IRIG Scale Factor error in parts per million, Position -00001).

6.2.15.16 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00002 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM lamp is ON, enter VERB 36 ENTR and repeat steps 6.2.15.4 through 6.2.15.7 and 6.2.15.16.

6.2.15.17 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (-Y IRIG Scale Factor error in parts per million, Position -00002).

6.2.15.18 On K-148 enter the following sequence:

VERB 33 ENTR (VERB 21 NOUN 30 shall flash)
-00003 ENTR
NOTE: If PROG lamp changes from 07 to 00 during the next step, or PROG ALARM is ON, enter VERB 36 ENTR and repeat steps, 6.2.15.4 through 6.2.15.7 and 6.2.15.18.

6.2.15.19 In approximately 160 seconds, VERB 06 NOUN 66 shall flash. Read and record from CRT DSKY Row 1 (+Z IRIG Scale Factor error in parts per million, Position -00003).

6.2.15.20 Repeat steps 6.2.15.8 through 6.2.15.19 twice to obtain second and third set of data.

6.2.15.21 Terminate this test by entering in K-148: VERB 34 ENTR

6.2.15.22 The average of the three readings of Scale Factor Error for each of the 6 positions shall be 0±1750 PPM.

6.2.16 **IMU Performance Test**

6.2.16.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.

6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.

6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBBB.

6.2.16.5 Perform the following calculations:

a. $\frac{\text{R1 (BBBBB) X 5.12}}{3600}$ = CCCC.C (hrs. in high order scaler channel 3)

b. 23.3 - CCC.C = DDDDD Hrs.

c. Add DDDDD to time of day recorded in step 1.

Do Not enter any of the PIPA scale factor tests within -0.2 hours of the time of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter the following into K148.

a. VERB 01 NOUN 01, ENTER
b. 00362, ENTER
Record R1 = XXXXY

6.2.16.7.2 Enter the following into K148

a. VERB 21 NOUN 01, ENTER
b. 00362, ENTER
c. XXXXY', ENTER where Y' is determined by Table XV and XXXX is that recorded in 6.2.16.7.1.

TABLE XV

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 On the CRT, DSKY display verify R1 (Navigation Base Azimuth) and R2 (Site Latitude) are correct.

6.2.16.7.6 If values for R1 and R2 are correct, proceed to next step. If values for R1 and R2 are incorrect, enter the following sequence into K-148.

VERB 24 ENTR
±XXX.XX ENTR (Correct navigation base azimuth ±0.50 deg)
+XX.XXX ENTR (Correct site latitude from Table XX)
Verify values in R1 and R2 are correct

TABLE XX

LOCATION	LATITUDE
NAA	+33.921
MSC	+29.556
MILA	+28.516

6.2.16.7.7 On K-148 enter the following sequence:

VERB 33 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.8 On CRT, DSKY display, verify R1 = +00900 (Time), R2 = +00000 (Test Index No.) and R3 = +00001 (Test Position). If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00001 ENTR (Test Position Entry)

6.2.16.7.9 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.10 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY) Position +00001.

6.2.16.7.11 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.12 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (+X PIPAS) Position +00001. Row 1 is whole part, Row 2 is fractional part, Units are cm/sec.

6.2.16.7.13 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.14 On CRT DSKY displays, verify R1 = +00900, R2 = +00000, and R3 = +00002.

If values for R1, R2 and R3 are correct, proceed to next step.
If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00002 ENTR (Test Position Entry)

6.2.16.7.15 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.16 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDZ) Position +00002.

6.2.16.7.17 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.18 In approximately 90 secs. VERB 06 NOUN 66 shall flash. From the CRT, record R1 and R2 (-X PIPAG) Position +00002.

6.2.16.7.19 On K-148 enter the following sequence:

VERB 21	NOUN 01	ENTR
00407		ENTR
77757		ENTR
VERB 21	NOUN 01	ENTR
00411		ENTR
00020		ENTR
VERB 33		ENTR

6.2.16.7.20 In approximately 67 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX + ADIAX) Pos +00002, Record CRT CDU gimbal angle indications and time.

6.2.16.7.21 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.22 On CRT, DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00003.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00003 ENTR (Test Position Entry)

6.2.16.7.23 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.24 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDX) Position +00003.

6.2.16.7.25 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.26 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Z PIPAG) Position +00003.

6.2.16.7.27 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.28 On the CRT, DSKY display verify R1 = +00900, R2 = 00000, and R3 = +00004.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00004 ENTR (Test Position Entry)

6.2.16.7.29 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.30 In approximately 17 minutes, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+NBDY +ADSRAY) Position +00004.

6.2.16.7.31 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.32 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R1 and R2 (-Z PIPAG) Position +00004.

6.2.16.7.33 On K-148 enter the following sequence:

VERB 21 NOUN 01 ENTR
00405 ENTR
00020 ENTR
VERB 21 NOUN 01 ENTR
00407 ENTR
77757 ENTR
VERB 33 ENTR

6.2.16.7.34 In approximately 67 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 (+NBDZ + ADIAZ) Position +00004. Record CRT CDU gimbal angle indications and time.

6.2.16.7.35 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.36 From the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00005.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00005 ENTR (Test Position Entry)

6.2.16.7.37 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.38 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.

6.2.16.7.39 In approximately 90 secs, VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2 (+Y PIPAG) Position +00005.

6.2.16.7.40 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

[illegible] [illegible] display, verify R1 = [illegible], R2 = [illegible] and R3 = [illegible].

VERB 34 . ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.41 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00006.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00006 ENTR (Test Position Entry)

6.2.16.7.42 On K-148 enter the following sequence;

VERB 33 ENTR

6.2.16.7.43 The PROG alarm and GIMBAL LOCK lamps shall light. Press Error Reset. The PROG alarm lamp shall extinguish.

6.2.16.7.44 In approximately 90 secs VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R1 and R2. (-Y PIPAG) Position +00006.

6.2.16.7.45 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.46 On the CRT DSKY display, verify R1 = +00900, R2 = +00000 and R3 = +00007.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2, and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00007 ENTR (Test Position Entry)

6.2.16.7.47 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.48 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (+.707 ADSRAX-NBDX) Position +00007.

6.2.16.7.49 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.50 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00008.

6.2.16.7.51 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.52 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 [-.707 (NBDZ+NBDY) +0.5 (ADIAZ-ADIAY) +0.5 (ADSRAY + ADSRAZ)] Position +00008.

6.2.16.7.53 On K-148 enter the following:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.54 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00009.

If values for R1, R2 and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00009 ENTR (Test Position Entry)

6.2.16.7.55 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.56 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display, record R2 (-NBDZ +.707 ADSRAZ) Position +00009.

6.2.16.7.57 On K-148 enter the following sequence:

VERB 34 ENTR
VERB 06 NOUN 66 shall flash

6.2.16.7.58 On the CRT DSKY display, verify R1 = +00900, R2 = +00000, and R3 = +00010.

If values for R1, R2, and R3 are correct, proceed to next step. If values for R1, R2 and R3 are incorrect, enter the following sequence into K-148:

VERB 25 ENTR
+00900 ENTR (Test Time in Seconds)
+00000 ENTR (Test Index Number)
+00010 ENTR (Test Position Entry)

6.2.16.7.59 On K-148 enter the following sequence:

VERB 33 ENTR

6.2.16.7.60 In approximately 17 minutes VERB 06 NOUN 66 shall flash. From the CRT DSKY display record R2 [.707 (NBDY-NBDX) + .5 (ADIAY-ADIAX) +.5 ADSRA X] Position +00010.

6.2.16.7.61 Terminate this test by entering in K-148 the following:

VERB 36 ENTR

6.2.16.7.62 On K-148 enter the following sequence:

VERB 41 NOUN 20 ENTR
+00000 ENTR
+00000 ENTR
+00000 ENTR

6.2.16.9 Deleted.

6.2.16.10.1 **Measured Values**

	Line	Position No.	Step No.	Parameter	Recorded Value
6.2.16.10.1.1	1	+00001	6.2.16.7.10	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.12	+XPIPAG	R1 . R2
6.2.16.10.1.3	3	+00002	6.2.16.7.16	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.18	-XPIPAG	R1 . R2
6.2.16.10.1.5	5	+00002	6.2.16.7.20	-NBDX+ ADIAX	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.24	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.26	+ZPIPAG	R1 . R2
6.2.16.10.1.8	8	+00004	6.2.16.7.30	+NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.32	-ZPIPAG	R1 . R2
6.2.16.10.1.10	10	+00004	6.2.16.7.34	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.39	+YPIPAG	R1 . R2
6.2.16.10.1.12	12	+00006	6.2.16.7.44	-YPIPAG	R1 . R2
6.2.16.10.1.13	13	+00007	6.2.16.7.48	-NBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.52	.707 (-NBDZ-NBDY) + .5 (ADIAZ-ADIAY) +.5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.56	-NBDZ + .707ADSRAZ	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.60	.707 (NBDY - NBDX) + .5 (ADIAY - ADIAX) + .5 ADSRAX	R2

ADDENDUM IV

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems which have the RESTART MONITOR package, P/N 2898989.

Change 1: Add the following paragraphs after Paragraph 5.13.4:

5.13.5 Whenever an unexplained RESTART occurs perform the following steps on K-148:

VERB 01 NOUN 10 ENTR
00077 ENTR

Record the value of R1.

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

5.13.5.1 The contents of R1 should be interpreted as follows:

Channel 77 Code (Octal)	Alarm Source
001	** * Parity Fail (F Memory)
003	** * Parity Fail (E Memory)
004	** TC Trap
010	** Rupt Lock
020	** Nightwatchman
040	*** Voltage Fail
100	Counter Fail
200	Scaler Fail
400	Scaler Double Frequency Alarm

*Note: Parity Fail will occur either in E or F Memory, but not in combination .

**Note: Depending on when the various alarms occur, a Counter Fail alarm may also occur and bit 7 will therefore be set also.

***Note: Other alarms will probably occur before the Voltage Fail Alarm occurs, in which case the contents of Channel 77 will contain the octal sum of all the alarms but it will contain the Voltage Fail Code.

Change 2: Add the following step after Paragraph 6.2.1.4.1:

6.2.1.4.1.1 Enter the following into the K-START:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 3: Add the following step after Paragraph 6.2.5.2.3:

6.2.5.2.3.1 Enter the following into the K-START:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 4: Add the following paragraph in the proper sequence:

6.2.2.6.1.1 Enter the following into the K-START:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify R1 = 00001 or R1 = 00101.

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

Change 5: Add the following paragraph after Paragraph 6.2.2.7.1:

6.2.2.7.1.1 Enter the following into the K-START:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify R1 = 00010 or R1 = 00110.

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

Change 6: Add the following paragraph after Paragraph 6.2.2.7.4:

6.2.2.7.4.1: Enter the following into the K-START:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify R1 = 00010 or R1 = 00110.

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

Change 7: Add the following paragraph after Paragraph 6.2.2.8.1:

6.2.2.8.1.1 Enter the following into the K-START:

```
VERB 01 NOUN 10 ENTR
00077           ENTR
```

Verify R1 = 00004 or R1 = 00104.

```
VERB 21 NOUN 10 ENTR
00077           ENTR
00000           ENTR
```

Change 8: Add the following step after Paragraph 6.2.2.8.4:

6.2.2.8.4.1 Enter the following into the K-START:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify R1 = 00004 or R1 = 00104.

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 9: Add the following step after Paragraph 6.2.2.9.1:

6.2.2.9.1.1 Enter the following into the K-START:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify R1 = 00020 or R1 = 00120.

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 10: Add the following step after Paragraph 6.2.19.10:

6.2.19.10.1 Enter the following into the K-START:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify bit 6 of R1 display is ON, other bits may also be ON.

Change 11: Add the following step after Paragraph 6.2.19.11:

6.2.19.11.1 Insert into K-148:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 12: Add the following step after Paragraph 6.2.19.17.1:

6.2.19.17.1 Enter the following into the K-START:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify bit 6 of the R1 display is ON, other bits may be ON.

Change 13: Add the following step after Paragraph 6.2.19.18:

6.2.19.18.1 Insert the following into K-148:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 14: Add the following paragraph after Paragraph 6.2.19.24:

6.2.19.24.1 Enter the following into the K-START

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify bit 6 of R1 is ON, other bits may also be ON.

Change 15: Add the following step after Paragraph 6.2.19.25:

6.2.19.25.1 Insert the following into K-148:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 16: Add the following step after Paragraph 6.2.19.31:

6.2.19.31.1 Enter the following into the K-START:

VERB 01 NOUN 10 ENTR
00077 ENTR

Verify bit 6 of the R1 display is ON, other bits may also be ON.

Change 17: Add the following step after Paragraph 6.2.19.33:

6.2.19.33.1 Insert the following into K-148:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 18: Add the following step after Paragraph 6.2.2.10.10.

6.2.2.10.10.1 Enter the following on K-148 if the RESTART lamp lights in the previous step.

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

APOLLO G&N Specification
ND1002325 REV Z
Original Issue Date:
Release Authority: TDRR 31414
Class A Release

POST INSTALLATION CHECKOUT PROCESS SPECIFICATION FOR THE APOLLO GUIDANCE AND NAVIGATION SYSTEM - BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
5/9/69	U	37563	90, 93, 128-131	EA	RJJ
10/1/69	V	37863	25, 26	EA	MDH
10/15/69	W	37886	74-167; was 167 pages, now 168 pages.	EA	MDH
11/3/69	Y	37911	11, 12, 74-105, 107; was 168 pages, now 172 pages JFO/AC	EA	MDH
3/23/70	Z	38083	17, 25, 27, 41, 43, 44, 46, 52, 53, 80, 143, 144, 169	EA	MDH

APPROVALS	Not required per CCA-497-0274 NASA/MSC	MIT/IL	R. D. Petryk D. A. Ziemer AC

6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyro and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.

6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.

a. UP TLM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.
b. LAUNCH VEHICLE — GUIDANCE switch on MDC Panel 2 shall be set to IU.
c. The SC CONT switch on MDC Panel 1 shall be set to CMC.
d. The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
e. The Δ V CG switch on MDC Panel 1 shall be set to CSM.
f. The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.

6.1.1.7 The 28 VDC input power requirements to the G&N System shall be met using the following:

Single Bus (CC 0206 or CC 0207): Min 27.0 VDC
Max 33.1 VDC

Dual Bus (CC 0206 or CC 0207): Min 26.8 VDC
Max 32.9 VDC

NOTE: The limits for dual bus operation apply to either bus.

6.1.2 The following optical reference alignment requirements shall be demonstrated.

6.1.2.1 G&N Installation Qualification Fixture

6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Autoset) LOS shall be located approximately 40 degrees (CW when viewed from above) from the SCZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT ST LOS.

6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ±30 minutes of arc.

6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 80 degrees from the SXT Optical Reference No. 1 (40 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT STAR LOS.

6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

6.2.1.1 Verify that spacecraft power checks, to include polarity and magnitude on Spacecraft Power Connector, have been made as specified in 6.1.3.

6.2.1.2 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.

6.2.1.3 The Inertial Component Temperature Controller (ICTC) shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.

6.2.1.4 Computer Power On

6.2.1.4.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).

NOTE: Restart Lamp may illuminate, if it does, disregard and press RSET on the DSKY.

6.2.1.4.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.

6.2.1.4.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.

6.2.1.4.4 The +28 VDC CMC OPERATE voltage (CG 1520) shall be +28.0±3 VDC. Verify CRT indication. On the G&N Indicator Control Panel verify PGNS light is ON.

6.2.1.4.4.1 Enter the following into K-148:

VERB 21 NOUN 01	ENTR
03700	ENTR
33663	ENTR
NOUN 15	ENTR
55426	ENTR ENTR
04064	ENTR ENTR
15374	ENTR
VERB 25 NOUN 26	ENTR
20000	ENTR
01700	ENTR
12007	ENTR
VERB 30	ENTR

On the DSKY verify TEMP light is ON.

6.2.1.5 IMU HTR Heater Power On

6.2.1.5.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.5.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513). On DSKY verify TEMP light is extinguished. On the G&N Indicator Control Panel verify PGNS light is extinguished.

6.2.1.5.3 Record the value of the following signals displayed on the CRT.

	Signal	Requirement
a.	CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6±0.6 VRMS
b.	CG 1510 + 28 VDC STANDBY POWER	28.0 (±3) VDC

6.2.1.5.4 30 minutes after entering the IMU Standby Mode start recording PIPA TEMP every 5 minutes until the PIPA temperature is stabilized. The PIPA temperature shall be considered stabilized when the temperature change is not more than 0.1 deg for 30 minutes. Record the PIPA Standby Mode stabilized temperature. The recorded temperature shall be 130.5±1.5 degrees.

6.2.1.5.5 Deleted

6.2.1.5.6 On the Event Recorder, verify that the IMU HEATER Current discrete (CG 2302) is ON and that the IMU BLOWER Current discrete (CG 2303) is OFF over the PIPA Standby Temperature stabilization period (occasionally discretes may cycle.)

6.2.1.5.7 With the eyepiece in the Eyepiece Storage Unit, check the eyepiece surface temperature at the quick disconnect flange using an L&N #8693 Temperature Potentiometer, or a similar type thermocouple probe meter. Record both the ambient and eyepiece surface temperatures and verify that the eyepiece surface temperature is above the ambient temperature by at least 5°F but not more than 30°F.

6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

a. CG 2117 IGA Servo Error In Phase
b. CG 2177 OGA Servo Error In Phase
c. CG 2147 MGA Servo Error In Phase
d. CG 2112 IG IX Resolver Output Sin
e. CG 2172 OG IX Resolver Output Sin
f. CG 2142 MG IX Resolver Output Sin
g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G & N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

a. Turn on the IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
b. Start Analog Recorders.
c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

a. The IMU Operate Power is +28.0±3 vdc (CG 1500). Verify on CRT.
b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin

c. Deleted. [illegible]
d. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90±10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read +120±6 VDC.

After approximately [illegible] seconds, the voltage shall read +120±6 VDC.

d. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90±10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read +120±6 VDC.

6.2.4.9 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breaker Panel and LEB:

a. G/N POWER-OPTICS to OFF
b. OPTICS MN B to ON (pushed in) and OPTICS MN A to OFF (pulled out).
c. G/N POWER - IMU to OFF
d. IMU MN B to ON (pushed in) and IMU MN A to OFF (pulled out).
e. IMU HTR MNA to OFF (pulled out)
f. G/N - POWER to OFF
g. COMPUTER MN B to ON (pushed in) and COMPUTER MN A to OFF (pulled out).
h. On GNIC panel, set OPTICS ZERO to OFF.

6.2.4.10 Verify that the +28 VDC CMC OPERATE output voltage is +28.0±3 VDC (CG 1520).

6.2.4.11 Set the G/N - POWER switch on the LEB to AC2. Set the IMU HTR MN B to ON (pushed in). Verify that the +28 VDC IMU STANDBY output voltage is +28.0±3 VDC (CG 1500).

6.2.4.12 Wait until 15 minutes have elapsed since setting G/N POWER - IMU to OFF in 6.2.4.9.c then set the G/N POWER - IMU to IMU. Verify that the +28 VDC IMU OPERATE output Voltage is +28.0±3 VDC. (CG 1500).

6.2.4.13 Set the G/N POWER - OPTICS to OPTICS. Verify that the +28 VDC OPTX OPERATE output voltage is +28.0±3 VDC (CG 1530).

6.2.4.13.1 Drive optics in trunnion to less than 5 degrees. Set OPTICS ZERO to ZERO.

6.2.4.14 Repeat 6.2.4.5 through 6.2.4.8.

6.2.4.15 Set the following circuit breakers to the position indicated:

a. Set the COMPUTER MN A to ON (pushed in).
b. Set the IMU HTR MNA to ON (pushed in).
c. Set the IMU MNA to ON (pushed in).
d. Set the OPTICS MN A to ON (pushed in).

6.2.4.16 Miscellaneous Checks - The following miscellaneous signals are required to supply data for system evaluation in the event of failure, or for trend analysis of system performance. Record the values displayed on the CRT for the following signals.

a. CG 4300 CMC Temperature
b. CG 6020 PIPA Calibration Module Temperature
c. CG 6021 IMU 800 CPS 5% Temperature

6.2.5.2.10 Immediately begin monitoring the following measurements.

a. On the CRT verify that IMU Operate Power is ±28.0 ±3 VDC (CG 1500).

b. On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:

CG 2112	IG 1X Resolver Output Sin
CG 2142	MG 1X Resolver Output Sin
CG 2172	OG 1X Resolver Output Sin

c. On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90±10 seconds following power application. After approximately 100 seconds, the voltage shall read +120 ±6 VDC.

6.2.5.2.11 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.5.2.12 Enter and verify VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.5.2.13 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-NOUN display on the CRT shall flash and indicate 21-22.

6.2.5.2.14 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.

6.2.5.2.15 Set the G&N OPTICS MN A and MN B circuit breakers on the Right Hand circuit breaker panel to the ON position (breaker pushed in).

6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2 KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS
13 CG 2300	PIPA TEMPERATURE
~~14 CG [illegible]~~	~~[illegible] TEMPERATURE~~

6.2.5.2.17 Monitor the PIPA Display Scope to insure that each PIPA is moding properly.

6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

6.2.5.3 Master Initialization

6.2.5.3.1 Set/Verify the following Circuit Breakers to ON.

a. G&N COMPUTER MN A & MN B
b. G&N POWER AC1 & AC2
c. G&N IMU HTR MNA & MNB

NOTE: If IMU OPERATE POWER is not ON, refer to paragraph 6.2.5.2.9.

d. G&N IMU MNA & MNB

6.2.5.3.2 Verify/Record the following measurements:

a. PIPA Temperature (CG 2300) 130±1.5°F.
b. +28 VDC CMC OPERATE BUS (CG 1520) 28.0±3 VDC.

NOTE: If the GIMBAL LOCK light on the DSKY is lit, proceed to paragraph 6.2.5.3.5.

6.2.5.3.3 Enter VERB 36, ENTER into K148.

6.2.5.3.4 Enter VERB 40 NOUN 20, ENTER into K148.

6.2.11.15 Set the OPTICS COUPLING switch on the G&N Panel to DIRECT. Using the OPTICS CONTROL STICK and a convenient CONTROLLER SPEED switch setting, carefully slew the SXT Trunnion to within +5 degrees of zero as indicated by the TPAC (Telescope Trunnion Slaved to SXT). Set the OPTICS ZERO switch to ZERO.

NOTE: If Optics testing will continue, set the G/N POWER OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Functional Test

Proceed with this test if 6.2.3 Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.1 Set/Verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Set Tracker switch to OFF. Verify the following:

a. +28 VDC OPTX OPERATE BUS (CG 1530) is 28.0±3 VDC. Record the indication on the CRT.

b. CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.

c. CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.2 Enter the following sequence into the K-Start.

a. VERB 41, NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.12.3 Insure that Optics Control switches on the G&N Indicator Control Panel are set as follows:

a. OPTICS ZERO to OFF
b. OPTICS MODE to MAN
c. OPTICS SPEED to LO
d. OPTICS COUPLING to DIRECT
e. OPTICS TEL TRUN to SLAVE to SXT

APPENDIX I

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	1	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	1	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	2	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	1	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	1	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	1	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	1	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2	2.5 VDC TM BIAS	+2.50 ± 0.06 VDC	0%
CG 1201	2	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	1	IMU 28V .8KC 5% -90° RMS	28.0 ± 1.4 VRMS	0.33%
CG 1203	1	IMU 28V .8KC 0° RMS	28.0 ± 2.1 VRMS	0.33%
CG 1207	1	PH DIFF IMU 5% 0°, -90°	-90 ± 10°	2.3%
CG 1211	1	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	0.33%
CG 1212	1	OPTX 28V .8KC 5% -90° RMS	28.00 ± 1.48 VRMS	0.33%
CG 1220	1	PH DIFF OPTX 1% IMU 1%	0° ± 10°	2.3%
CG 1331	2	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	1	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	2.3%
CG 1500	1	+28 VDC IMU OPERATE BUS	28.0 ± 3 VDC	0%
CG 1510	1	+28 VDC IMU STANDBY BUS	28.0 ± 3 VDC	0%
CG 1520	1	+28 VDC CMC OPERATE BUS	28.0 ± 3 VDC	0%
CG 1530	1	+28 VDC OPTX OPERATE BUS	28.0 ± 3 VDC	0%
CG 2001	2	X PIPA SG O/P	5 VRMS max	3%
CG 2021	2	Y PIPA SG O/P	5 VRMS max	0.23%
CG 2041	2	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	1	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2112	2	IG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2113	2	IG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2117	2	IG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	2.0%
CG 2120	1	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	0%
CG 2138	1	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2142	2	MG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2143	2	MG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2147	2	MG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	2.0%
CG 2150	1	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 2168	1	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3.6%
CG 2172	2	OG 1X RESOLVER O/P SIN	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2173	2	OG 1X RESOLVER O/P COS	18.38 ± 1.84 VRMS at 45°	2.5%
CG 2177	2	OG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS at null	2.0%
CG 2180	1	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	0%
CG 1042	1	+120 VDC PIPA SUP NOISE RMS	1.5 VRMS max	0%
CG 1053	1	+20 VDC PIPA SUP NOISE RMS	1.0 VRMS max	0%
CG 1071	1	+4 VDC CDU SUP NOISE RMS	0.10 VRMS max	0%
CG 1501	1	+28V IMU OPERATE BUS NOISE RMS	1.0 VRMS max	0%
CG 1511	1	+28V IMU STANDBY BUS NOISE RMS	1.0 VRMS max	0%
CG 1521	1	+28V CMC OPERATE BUS NOISE RMS	2.0 VRMS max	0%
CG 1531	1	+28V OPTX OPERATE BUS NOISE RMS	2.0 VRMS max	0%

Signal	Link	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 2219	1	PITCH ATT ERROR - CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2220	1	IG CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 2221	1	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS at null	0.29%
CG 2249	1	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2250	1	MG CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 2251	1	MG CDU COARSE ERROR	0.0 ± 0.68 VRMS at null	0.29%
CG 2279	1	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS at 17°	0.67%
CG 2280	1	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	0.29%
CG 2281	1	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	0.29%
CG 2300	1	PIPA TEMPERATURE	130.5 ± 1.5°F Operate Mode	2%
CG 3011	2	TRUNNION CDU FINE ERROR	0.0 ± 0.07 VRMS at null	1.0%
CG 3021	1	SHAFT CDU FINE ERROR	0.0 ± 0.07 VRMS at null	0.29%
CG 3117	1	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	1.1%
CG 3118	1	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	1.1%
CG 3140	1	SXT SHAFT TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3145	1	SXT SHAFT MTR CONTROL WINDING	+0.50 to +4.00 VRMS Med Rate	1.1%
CG 3150	1	SXT TRUNNION TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3155	1	SXT TRUNNION MTR CONTROL WINDING	+0.25 to +2.00 VRMS Med Rate	1.1%
CG 3160	1	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS at Hi Rate	1.1%
CG 3170	1	SCT TRUNNION TACH O/P	0.85 ± 0.35 VRMS at Hi Rate	1.1%
CG 3721	1	SHAFT CDU DAC O/P	10.12 ± 1.00 VRMS at 17°	1%
CG 3722	2	TRUNNION CDU DAC O/P	10.12 ± 1.00 VRMS at 17°	1%
CG 4300	2	CMC TEMP	87.5 ± 42.5°F	0.0%
CG 6020	1	PIPA CAL MODULE TEMP	72.5 ± 27.5°F	0.23%
CG 6021	1	IMU 800 cps 5% TEMP (PSA)	90 ± 30°F	0.23%
CG 2301	1	IRIG TEMPERATURE	135 ± 2.5°F in Operate	2%
CG 1021	1	+14V CMC SUPPLY NOISE RMS	0.2 VRMS max	0%
CG 1031	1	+4 CMC SUPPLY NOISE RMS	0.2 VRMS max	0%

PSAAM OUTPUT is the source of Link 1 signals.
SCA OUTPUT is the source of Link 2 signals.

ADDENDUM IV

SCOPE: The following changes are required to make ND1002325 applicable as G&N System technical support documentation for systems which have the RESTART MONITOR package, P/N 2898989.

Change 1: Add the following paragraphs after Paragraph 5.13.4:

5.13.5 Whenever an unexplained RESTART or CMC Warning occurs, perform the following steps on K-148:

VERB 01 NOUN 10 ENTR
00077 ENTR

Record the value of R1.

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

5.13.5.1 The contents of R1 should be interpreted as follows:

Channel 77 Code (Octal)	Alarm Source
001	** * Parity Fail (F Memory)
003	** * Parity Fail (E Memory)
004	** TC Trap
010	** Rupt Lock
020	** Nightwatchman
040	*** Voltage Fail
100	Counter Fail
200	Scaler Fail
400	Scaler Double Frequency Alarm

*Note: Parity Fail will occur either in E or F Memory, but not in combination .

**Note: Depending on when the various alarms occur, a Counter Fail alarm may also occur and bit 7 will therefore be set also.

***Note; Other alarms will probably occur before the Voltage Fail Alarm occurs, in which case the contents of Channel 77 will contain the octal sum of all the alarms but it will contain the Voltage Fail Code.

Change 2: Add the following step after Paragraph 6.2.1.4.1:

6.2.1.4.1.1 Enter the following into the K-START:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

Change 3: Add the following step after Paragraph 6.2.5.2.3:

6.2.5.2.3.1 Enter the following into the K-START:

VERB 21 NOUN 10 ENTR
00077 ENTR
00000 ENTR

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Post-Installation Checkout Process Specification For The Apollo Guidance & Navigation System (Spacecraft 17 and 20, KSC)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised
2/13/67	A	32968	2,3,5-12,14,17-107, was 107 pages, now 113 pages.

This specification consists of page 1 to 113 inclusive.

APPROVALS	NASA/MSC		ACED

NUMBER	REVISION LETTER	PAGE

1. INTRODUCTION

1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one each of the following major assemblies:

Assembly Name	NAA Drawing No.
Equipment Install-Block I, Series 100 Guidance & Navigation, LWR Equip. Bay	V16-724019
Equip Install - Block I G&N Main Display Console	V16-724006

1.2 The G&N System herein shall be identified as a Block I, Series 100 G&N System. The computer contains the **SOLARUM 55** **programs in the core** rope memory modules.

2. SCOPE

2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module, Spacecraft 017 at Kennedy Spacecraft Center, Florida. This specification also outlines the checkout requirements for the G&N System installed in the Apollo Command Module, Spacecraft 020 at Kennedy Spacecraft Center, Florida, as modified by Addendum 1 to this specification.

3. APPLICABLE DOCUMENT

3.1 Documents required by this specification.

3.1.1 When the requirements of this specification conflict with the drawing requirements, the drawing requirements shall have precedence.

ATP 1026000	Pre-installation Assembly Test Procedure for the Apollo Guidance and Navigation System P/N 1015000, Block I, Series 100
FTM 1026000	Final Test Method for G&N System
ICD MH01-01220-216	Interconn Diagram - AGC to AGC DSKY (Main Display Panel)
ICD MH01-01224-416	Attitude Error Signals
ICD MH01-01225-416	Total Attitude Signals
ICD MH01-01226-200	Central Timing Equipment Sync. Pulse
ICD MH01-01227-216	G&N Electrical Input Power
ICD MH01-01228-416	G&N Data Transmission to Operational PCM-Telemetry Equipment
ICD MH01-01236-200	ACE Uplink/SC Digital Up-DATA Link AGC
ICD MH01-01237-216	G&N Hold Attitude
ICD MH01-01249-416	G&N Thermal Requirement
SID 63 517	Apollo Command Module/Service Module Measurement Requirements for SC 017 and 020.
MA0201-0499	ACE S/C Computer Subprograms
MA 0308-0049	Component Installation Procedure - Apollo Guidance Equipment S/C 017

4. MATERIAL AND EQUIPMENT

4.1 The following test equipment shall be used to perform the requirements of this specification. If protection to personnel and equipment is not decreased, items except government furnished parts, equivalent to those listed may be used.

Item	Quantity	Description
1	1	Carry-on Receiver and Baseplate Unit,
2	1	Carry-on Baseplate Unit, Model No. C14-201
3	1	Junction Box ACE S/C Carry-on, Model No. C14-202
4	1	Carry-on ACE S/C Response System Support Rack, Model No. C14-203
5	1	Support Frame Carry-on DTCS, Model No. C14-204
6	1	Carry-on PCM System, Model No. C14-210
7	1	Digital Signal Conditioner and Multiplexing Unit, Model No. C14-211
8	1	G&N Signal Conditioner and Switching Matrix, Model No. C14-213
9	1	External Digital Test Command Unit, Model No. C14-241
10	1	Data Interleaver System, Model No. C14-232
11	1	S/C Ground Power Supply, Model No. C14-418
12	1	Breakout Box - Test C/M-S/M Adapter, Model No. C14-467
13	1	Electrical Cable Set, Model No. C14-478
14	1	LTC Lifting Temperature Controller
15	1	PSA Test Point Adapter, Model No. A23-167

4.1 (continued)

Item	Quantity	Description
16	1	Inertial Components Temperature Controller (ICTC) Model No. S23-100
17	1	PSA Adapter Module, Model No. A23-201
18	1	Volt Ohmeter Simpson, Model No. 269 or equivalent
19	1	Calculator (Friden or equivalent)
20	1	E-Memory Zeroing Tape No. F04C017-K00012-XX *
21	1	Stopwatch
22	1	Shorting Plug No. 45A7P2
23	1	Electrical Cable Portable G&N System, Model No. C14-462
24	1	Optics Supporting Fixture, Model No. A14-135
25	1	G&N Installation Qualification Fixture, Model No. A23-097
26	1	SCT Resolution Check Card
27	1	DKM-3 Theodolite
28	1	Retroflecting Prism 1019840, Model No. A23-200
29	1	Movable Optics Target
30	1	Portable Light Assembly (Light Scanning Telescope)
31	1	Electronic Counter with Preset Counter (Hewlett-Packard 5245L with 5264A Preset or equivalent)
32	1	Flexible Driver TM-62A (or equivalent)
33	1	Hex Head Cap Screwdriver TM AL-5 (5/32 Hex) (or equivalent)
34	1	Carry-on Cable Set C14-574
35	1	AGC Alarms and Interrupts Test Tape, No. F04C017-K00020-XX *
36	1	Gimbal Friction Test Tape No. F04C017-K00031-XX *
37	1	Flt Rope Cont Sim Flt Tape F04C017 -K00040-XX *

* - XX signifies revision of tape. Use latest revision for testing purposes.

5. GENERAL REQUIREMENTS

5.1 Safety Requirements

5.1.1 Operator Safety

5.1.1.1 Normal safety precautions shall be observed throughout the G&N post-installation checkout.

5.1.2 Equipment Safety

5.1.2.1 To preserve the operational life of the components of the G&N hardware under test, settings and adjustments shall be performed only when specified in the test procedure. Care shall be exercised in the accomplishment of all settings and adjustments to avoid excessive wear and damage to the equipment. All precautionary measures stated throughout the test procedures shall be strictly adhered to.

5.1.2.2 Prior to the electrical connection of the G&N System to the spacecraft harness, a complete verification of spacecraft power, to include both voltage polarity and magnitude, shall be completed to preclude damage to the G&N due to incorrect power application.

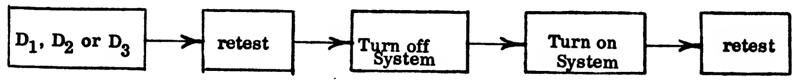
5.1.2.3 In no event shall the ICTC be disconnected from PSA Tray 7 except when specified to do so in a specific test.

5.1.2.4 The generation of noise alarm indication, as evidenced by one or more Noise Peak Event lamps becoming lighted shall be cause for immediate determination of effects on G&N System Test in progress. In the event of detrimental effects on the system test, a troubleshooting routine shall be entered to determine the cause of the alarm. Testing shall continue only after demonstrating that the cause of the noise alarm has been located and that remedial action has been or will be taken, or that the transient or noise causing the alarm has no detrimental effect on the G&N System test in progress.

5.1.2.5 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as non-conforming. Normal test sequence may be continued upon determination of the cause of the non-conformance or at the discretion of the G&N contractor test team if not detrimental to the G&N System or other interfacing subsystems. All non-conformances shall be investigated and cleared by waiver (F.N.N.), correction of specification, or hardware replacement and retest. The suspected malfunctioned hardware shall be removed and returned to the laboratory where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable element be installed in the G&N System.

5.1.2.5.1 Inertial Component Stability Failure.

5.1.2.5.1.1 If D_1, D_2, or D_3 exceeds the maximum values as indicated in 6.2.18.5.3.2, 6.2.18.5.4.2, and 6.2.19.24 for any PIPA or IRIG: that PIPA or IRIG shall be retested in the sequence indicated below. The coefficient stability terms shall then be recalculated.



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If D_1, D_2, and D_3 are within tolerance specified after retest, the original out of tolerance terms shall be exonerated.

If D_1, D_2, or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.1.2.5.1.1.1 (IRIGS) or 5.1.2.5.1.1.2 (PIPA's) shall apply.

5.1.2.5.1.1.1 Stability requirements. Failure to be within the maximum values of D_1, D_2, and D_3 after the retest sequence of 5.1.2.5.1.1 shall constitute a failure of the assembly.

5.2 Standard Environmental Conditions

5.2.1 The G&N System when installed in the Command Module shall be tested in an environment in accordance with ICD MH01-1248-416. At no time shall the dust particle count exceed level 300,000 of Federal Standard 209 with no more than 2,000 particles per cubic foot larger than 5 microns; no more than 35 particles larger than 65 microns with no more than 3 of these 35 larger than 100 microns in existance. Dust covers shall be installed, on the SXT and SCT, per ICD MH01-01250-116 when optics are not under test.

5.2.2 The Apollo G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD MH01-01249-416.

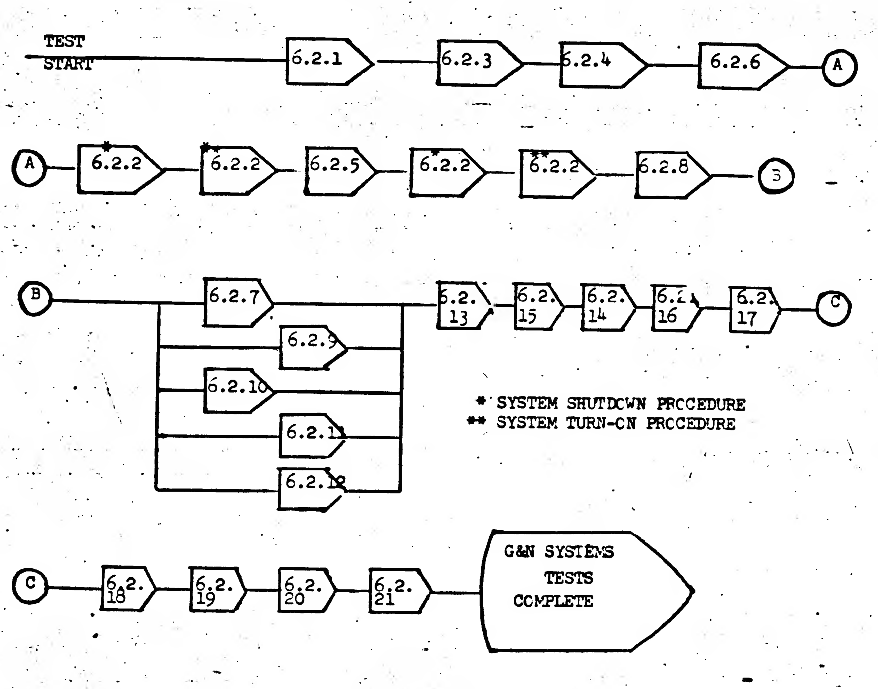
5.3 Test Equipment Tolerances

5.3.1 All tolerances specified herein do not include instrumentation uncertainties.

5.4 Test Sequence

5.4.1 The test Sequence normally should follow the steps outlined by Code numbers in Figure I in the order specified. This normal order can be deviated on approval by the G&N Steering Committee.

5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the subassembly in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading or as directed by NASA Test Engineering. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I. It must be noted that Table II is to be used only as a guide.



* SYSTEM SHUTDOWN PROCEDURE
** SYSTEM TURN-ON PROCEDURE

FIGURE 1

G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

TABLE I.
TEST SEQUENCE

PARAGRAPH NO.	TEST TITLE
6.2.1	Application of Standby Power to G&N System
6.2.2	Turn On and Shutdown Procedure
6.2.3	AGC Operational Test
6.2.4	Operate Power On and Power Supply Test
6.2.5	Gimbal Lock Test
6.2.6	G&N Operational Test
6.2.7	IMU Temperature Control Test
6.2.8	AGC Clock Frequency and Alignment Tests
6.2.9	G&N Panel Brightness and Lamp Test
6.2.10	Optics Servo Test
6.2.11	Optics Slew Rate Test
6.2.12	Optics Coordinate Transformation Control Test
6.2.13	Optics Positional Accuracy Test
6.2.14	AGC Mode Control Test
6.2.15	Gimbal Friction Test
6.2.16	Stabilization Loop Step Response Test
6.2.17	IRIG Scale Factor Test
6.2.18	PIPA Scale Factor Determination Test
6.2.19	IRIG Coefficient Determination Test
6.2.20	Fine Alignment Test SXT-NB-IMU
6.2.21	Gyro Compassing Test

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TABLE II. RETEST SEQUENCE

Paragraph Number	IMU	OPTICS & NAV BASE	AGC	PSA TRAY 1	PSA TRAY 2	PSA TRAY 3	PSA TRAY 4	PSA TRAY 5	PSA TRAY 6	PSA TRAY 7	PSA TRAY 8	PSA TRAY 9	PSA TRAY 10	G&N DSKY	MDC DSKY	D&C ELEC;	SIG COND	OCDU'S	ICDU'S	G&N HARNESS	GNIC PANEL
6.1.3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.2.1	X	X	X	X	X					X			X				X			X	
6.2.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6.2.3		X	X											X	X					X	
6.2.4	X	X	X	X	X				X	X			X			X	X	X	X	X	
6.2.5	X	X																		X	
6.2.6	X	X	X	X	X	X	X	X	X	X										X	
6.2.7	X	X		X						X										X	X
6.2.8		X	X																	X	
6.2.9		X												X	X	X		X	X	X	X
6.2.10		X	X						X		X	X					X	X		X	
6.2.11		X							X		X	X	X					X		X	X
6.2.12		X									X	X						X		X	X
6.2.13		X			X				X	X	X	X						X		X	X
6.2.14	X	X	X	X	X			X	X	X						X	X		X	X	
6.2.15	X	X			X	X	X													X	
6.2.16	X	X		X													X			X	
6.2.17	X	X		X	X	X	X	X												X	
6.2.18	X	X		X		X	X	X	X	X									X	X	
6.2.19	X	X		X		X														X	
6.2.20	X	X		X		X	X	X	X	X									X	X	
6.2.21	X	X			X					X										X	

5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Conductor should refer to the pertinent operational manuals.

5.7 The following requirements shall be completed before any of the tests in this specification are attempted.

5.7.1 The G&N System shall have been qualified in accordance with the requirements of the Pre-installation Assembly Test Procedure for the Apollo Guidance and Navigation System (ATP 1026000).

5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in process specification MA0308-0049, Mechanical Installation Specification for Apollo Guidance Equipment (S/C 017).

5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

5.8 The following conditions are required for testing the G&N System.

5.8.1 Spacecraft Systems other than the G&N System may be operating on a noninterfering basis while individual system checkout of the G&N System is being conducted.

5.8.2 The G&N System shall be supported by the Electrical Power System and Environment Control System during operation in the Command Module. The Stabilization and Control System shall be connected to the G&N System during G&N operation in the Command Module for passive loading purposes if available.

5.8.3 During tests which interface with the Stabilization and Control System and the Central Timing System, operation of these systems shall be required.

5.9 The G&N System shall be tested per this specification after it is installed in the spacecraft. In the event that the installed system, or any assembly thereof, is removed from the spacecraft for modifications, recycle, or any other reason, this process specification or pertinent portions of it shall be performed after the G&N System, or assembly thereof, is reinstalled. Testing shall be limited to G&N System operation while actively connected to qualified spacecraft threshold systems, namely, the Electrical Power System (EPS), Environmental Control System (ECS), and Communications and Instrumentation System (C&IS) as much as possible. However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS), and Central Timing System (CTS) is required for complete G&N System verification.

5.10.3 Miscellaneous hardware required in support of G&N testing consists of the following:

a. Movable Optics Target

5.11 Data Record

5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out-of-tolerance readings shall be recorded and flagged by appropriate symbols to attention.

5.11.1.1 Test Data. All test data obtained while demonstrating the requirements of this document shall permanently be recorded and forwarded with the tested G&N to the next receiving agency.

5.11.1.2 An authorized Quality Control Representative shall monitor this test and verify compliance to this specification by signing or stamping applicable documents including all test data recorded. (Form 962-T or equivalent).

5.11.2 The PCM Raw Data magnetic tape recorder shall be turned on at all times while any portion of the G&N is operating.

5.11.3 The Event Recorder, 4A2-A2, shall be turned on at all times while any portion of the G&N System is operating.

5.12 Interface

5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface according to the ICD's listed below.

a.	ICM MH01-01220-216	Interconn Diagram-AGC to AGC DSKY (Main Display Panel)
b.	ICD MH01-01224-416	Attitude Error Signals
c.	ICD MH01-01225-416	Total Attitude Signal
d.	ICD MH01-01226-200	Central Timing Equipment Sync. Pulse
e.	ICD MH01-01227-216	G&N-Electrical Input Power
f.	ICD MH01-01228-416	G&N Data Transmission to Operational PCM-Telemetry Equipment
g.	ICD MH01-01236-200	ACE Uplink, SC Digital Up-Data Link AGC
h.	ICD MH01-01237-216	G&N-Hold Attitude
i.	ICD MH01-01249-416	G&N-Thermal Requirements
j.	ICD MH01-01248-416	G&N Subsystem Environment

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6. DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis unless otherwise specified. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. S23-100. The temperature of the inertial components shall not drop below 120°F while under control of the ICTC.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and COMPUTER MN B in the ON position and IMU MN A and MN B in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, IMU HTR MN B, COMPUTER MN A, COMPUTER MN B, the Computer Mode Control (CMC) switch to the ON position, and IMU MN A and IMU MN B in the ON position. The G&N System shall be operating in the Standby Mode (with CMC power ON) for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby Mode power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warm-up period shall be mandatory.

6.1.1.2.1 After 6.2.4.5 .3 and 6.2.2.1 have been performed and it is known that the spacecraft or IMU have not been moved, and that the shutdown period did not exceed 5 days, it is permissible to enter the IMU Operate Mode after the system has been in the Standby mode for a minimum of 15 minutes.

6.1.1.3 The Inertial Measurement Unit shall not be without Heater power for a period greater than 15 minutes.

6.1.1.4 During the turn on of G&N power, the COMPUTER MN A, COMPUTER MN B, IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power, the IMU MN A and IMU B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM.

6.1.1.5 A warm-up period of one hour with OPERATE power applied shall be required prior to performing any test in which gyro or accelerometer parameters are measured, and a 15 minute warm-up period to any test in which precision amplitude and frequency power supply checks are made.

6.1.1.6 The AGC Mode switch shall never be in the STANDBY position when Operate Power is supplied to the G&N System.

6.1.1.7 Remove Operate power if any of the following situations occur as indicated by observing the gimbal resolvers total attitude signals displayed on ACE meters. (CG2112 IGA 1X RES OUTPUT SINE IN PHASE, CG 2113 IGA 1X RES OUTPUT COS IN PHASE, CG 2142 MGA 1X RES OUTPUT SINE IN PHASE 2143 MGA 1X RES OUTPUT COS IN PHASE, CG 2172 OGA 1X RES OUTPUT SINE IN PHASE, and CG 2173 OGA 1X RES OUTPUT COS IN PHASE.

a. The gimbals do not stop moving within 15 seconds after first applying operate power while in coarse align.

b. The gimbals do not stop moving within 5-6 seconds after the IMU delay light goes out or when changing from coarse align to fine align attitude control or entry.

c. The gimbals do not stop moving within 5-6 seconds after inserting or removing the step Response Test input.

6.1.2 The UPTL switch on the MDC AGC DSKY Panel No. 14 shall remain in the ACCEPT Position except when otherwise specified as procedural function.

6.1.3 Pre-Power Application Requirements

Note: 6.1.3 shall be used in conjunction with Retest Sequence of Table II only.

CAUTION

Ensure that the power connection from the Inertial Component Temperature Controller or PTC is connected and remains connected to PSA TRAY 7 front panel connector, 45A7J2.

6.1.3.1 Prior to connecting G&N power connector 56P11 and 56P12 to spacecraft power connectors C27-1A16-J190 and C27-1A16-J191 respectively, it is necessary to perform a complete verification of spacecraft powerication of spacecraft power.

6.1.3.2 Ensure that G&N connectors 56P9, 05A3J2 and 45A1J1 through 45A10J1 are disconnected from their mating connectors.

6.1.3.3 Ensure that the circuit breakers as listed in Table V on the S/C Right Hand Circuit Breaker Panel are in the OPEN position. (Breakers pulled out)

6.1.3.4 Obtain Extender Cable set and insert connectors to G&N Connector 56P11 and 56P12, located at the lower rear portion of the Right Hand Support Panel.

6.1.3.5 Using a volt ohmmeter (4.1, Item 18), the resistance between the pins shall be as follows in Tables III and IV.

TABLE III

RESISTANCE REQUIREMENTS OF SC/G&N POWER

Test Number	Ground	From	To	Requirements	
1	OVDC IMU	56P11-D	56P11-L	5.0 mego	to infinity
2	OVDC IMU	56P11-D	56P11-G	1000.0 ohms	to infinity
3	OVDC IMU	56P11-D	56P11-J	1000.0 ohms	to infinity
4	OVDC IMU	56P11-D	56P11-K	5.0 mego	to infinity
5	OVDC IMU	56P11-D	56P11-E	0.0 ohms	to 0.5 ohms
6	OVDC IMU	56P11-D	56P11-F	0.0 ohms	to 0.5 ohms
7	OVDC IMU	56P11-D	56P12-D	0.0 ohms	to 0.5 ohms
8	OVDC Optics	56P11-G	56P12-G	0.0 ohms	to 0.5 ohms
9	OVDC AGC	56P11-J	56P12-J	0.0 ohms	to 0.5 ohms
10	Structure Grd	56P11-L	56P12-L	0.0 ohms	to 0.5 ohms
11	OVDC IMU	56P11-E	56P12-F	0.0 ohms	to 0.5 ohms
12	OVDC IMU	56P11-F	56P12-F	0.0 ohms	to 0.5 ohms
13	OVDC Optics	56P11-G	56P11-L	5.0 mego	to infinity
14	OVDC AGC	56P11-J	56P11-G	5.0 mego	to infinity
15	OVDC AGC	56P11-J	56P11-L	5.0 mego	to infinity
16	400-115V	56P11-K	56P11-L	5.0 mego	to infinity
17	400-115V	56P11-K	56P11-G	5.0 mego	to infinity
18	400-115V	56P11-K	56P11-J	5.0 mego	to infinity

TABLE IV

RESISTANCE REQUIREMENTS ON G&N POWER CONNECTORS

Test Number	From	To	Requirements	Test Results
1	56P11-A	56P11-J	2.4 ohms to infinity	
2	56P11-B	56P11-D	2.4 ohms to infinity	
3	56P11-C	56P11-D	2.4 ohms to infinity	
4	56P11-H	56P11-G	7.7 ohms to infinity	
5	56P11-M	56P11-D	11.8 ohms to infinity	
6	56P11-N	56P11-K	2.0 ohms to infinity	
7	56P12-A	56P12-J	2.4 ohms to infinity	
8	56P12-B	56P12-D	2.4 ohms to infinity	
9	56P12-C	56P12-D	2.4 ohms to infinity	
10	56P12-H	56P12-G	7.7 ohms to infinity	
11	56P12-M	56P12-D	11.8 ohms to infinity	

6.1.3.6 Disconnect connector 56P11 and 56P12 from the Extender Cable Set Connector.

6.1.3.7 Insert connectors of Extender Cable set to spacecraft power connectors C27-1A16-J190 and C27-1A16-J191.

6.1.3.8 Polarity and Voltage Check on SC/G&N Power

6.1.3.8.1 The following circuit breakers on the Right Hand Circuit Breaker Panel, as listed in Table V, shall be closed (breakers pushed in) and the voltage across the pins at specified SC connectors shall be within its requirements.

TABLE V

POLARITY AND VOLTAGE REQUIREMENTS ON SC/G&N POWER

Test Number	Subsystem Circuit Breakers	Polarity and Connector Pin No.		Requirements
		Low	High	
1	COMPUTER MN A	C27-1A16J-190-J	C27-1A16J-190-A	+27.3±2.5 VDC
2	OPTICS MN A	C27-1A16J-190-G	C27-1A16J-190-H	+27.3±2.5 VDC
3	IMU MN A	C27-1A16J-190-D, E, F	C27-1A16J-190-B, C	+27.3±2.5 VDC
4	IMU HTR MN A	C27-1A16J-190-F	C27-1A16J-190-M	+27.3±2.5 VDC
5	COMPUTER MN B	C27-1A16J-191-J	C27-1A16J-191-A	+27.3±2.5 VDC
6	OPTICS MN B	C27-1A16J-191-G	C27-1A16J-191-H	+27.3±2.5 VDC
7	IMU MN B	C27-1A16J-191-D, E	C27-1A16J-191-B, C	+27.3±2.5 VDC
8	IMU HTR B	C27-1A16J-191-F	C27-1A16J-191-M	+27.3±2.5 VDC
9	VIEWER AC 1	C27-1A16J-190-K	C27-1A16J-190-N	115±10 VAC
10	VIEWER AC 2	C27-1A16J-190-K	C27-1A16J-190-N	115±10 VAC

6.1.3.8.2 Open the circuit breakers as listed in Table V on the S/C Right Hand Circuit Breaker Panel (breakers pulled out).

6.1.3.8.3 Demate Extended Cable Set from spacecraft power connector C27-1A16-J190X and C27-1A16-J191.

6.1.3.8.4 Mate connector 56P11 to connector C27-1A16-J190.

6.1.3.8.5 Mate connector 56P12 to connector C27-1A16-J191.

6.1.3.8.6 Mate connector 56P9 to connector 30A1J1 (G&N Signal Conditioner).

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6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

NOTE: Alarm and fail indications may occur in 6.2.1.4.1 . . . . . while performing this test. Reset alarm by pressing the SYSTEM RESET pushbutton on the ICTC.

6.2.1.1 All power and control switches on the G&N Indicator and Display Panel shall be placed in the OFF or neutral position. Set IMU TEMP mode switch to AUTO OVERRIDE.

6.2.1.2 The Inertial Component Temperature Controller (ICTC) Model No. S23-100, shall be supplying inertial component heater power to the G&N System through Tray No. 7 front panel connector 45A7J2.

6.2.1.3 Computer Power On

6.2.1.3.1 Set the AGC MODE switch to ON position. Switch shall remain in the ON position unless specified otherwise as a procedural step.

6.2.1.3.2 Set G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position (breakers pushed in). Record the value of CG 1520, AGC +28V on the CRT (24.5 V to 30.5 V).

NOTE: Ignore AGC Alarms.

6.2.1.3.3 Set the LIGHTING AC1 and AC2 breakers on the Right Hand Circuit Breakers Panel to ON position (breakers pushed in).

6.2.1.3.4 Set the computer numerical display lights to the desired brightness by rotating the BRIGHTNESS thumbwheel on the LEB AGC DSKY and MDC AGC DSKY.

6.2.1.3.5 The AGC +28VDC power discrete shall be issued (CG 1523). This can be observed by the lighted AGC +28 VDC operate lamp on the Event Module.

6.2.1.3.6 Press ERROR RESET pushbutton. Enter VERB 36 in K 148. Press ENTER pushbutton. All computer alarms on the Main Display Console (MDC) and LEB AGC DSKY shall clear.

6.2.1.3.7 The voltage output of the +3 VDC AGC supply shall be +1.88 to +4.12 VDC, CG 1030. The value on CRT shall be recorded.

6.2.1.3.8 The voltage output of the +13 VDC AGC supply shall be +11.7 to 14.3 VDC, CG 1020. The value on CRT shall be recorded.

6.2.1.3.9 Verify that the AGC is in the Backup Mode by monitoring on CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

6.2.1.3.10 Obtain E Memory Zeroing Tape No. F04C017-K00012-XX and load the tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AGC memory locations.

6.2.1.3.11 Run the remaining portion of tape to initiate AGC Self Test. Wait approximately three minutes.

6.2.1.3.11.1 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT +1 and SCOUNT +2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67±2 seconds. Monitor R1, R2, and R3 until R1 equals 00003, and R2 and R3 equal 00002.

6.2.1.4 Standby Power Temperature Control Loop Tests.

6.2.1.4.1 Enter the IMU Standby Mode of Operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in). Record range time.

6.2.1.4.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted. (CG 1513)

6.2.1.4.3 Set ICTC Power ON-OFF switch to OFF position.

6.2.1.4.4 Record the value of the following signals displayed on CRT:

	Signal	Requirement
a.	CG 1301 2V 3200 CPS POWER SUPPLY	+2.8 to +4.2
b.	CG 1510 + 28 VDC STANDBY POWER	24.5 to 30.5 VDC
c.	CG 1511 +28 VDC STANDBY NOISE	0 to+0.7 VRMS

6.2.1.4.5 The IRIG TEMP and IMU HEATER CURRENT on CRT shall be monitored periodically for one hour to ensure that the IRIG Temperature Control Loop circuitry is operating to maintain a temperature of 128.5°F to 134.5°F and current of 0.75 to 1.60 amperes (when current is applied) (CG 2301) (2302).

6.2.1.4.6 The PIPA TEMP shall be monitored on CRT periodically for one hour to ensure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 128.5°F to 134.5°F (CG 2300). (To be completed concurrently with 6.2.1.4.5).

6.2.1.4.7 The G&N System shall be in the Standby Mode for a minimum of one hour before proceeding with 6.2.1.4.8, Temperature Control Loop Tests. The test of 6.2.3, AGC Operation Test, may be performed during this period.

6.2.1.4.8 Verify that the IMU TEMP MODE switch on the G&N Indicator Control Panel is set to AUTO OVERRIDE Position.

6.2.1.4.9 IRIG Temperature Bridge Calibration Test.

6.2.1.4.9.1 Press and hold ZERO pushbutton on the G&N Indicator Control Panel.

6.2.1.4.9.2 IRIG Temperature Indicating Bridge Amplifier output shall be 132.9°F to 134.1°F (CG 2301). Record indication of IRIG TEMP as displayed on CRT.

6.2.1.4.9.3 Release ZERO pushbutton. The IRIG Temperature Indication Bridge Amplifier output shall be 128.5°F to 134.5°F (CG 2301). Record CRT indication of IRIG Temperature.

6.2.1.4.10 IRIG Temperature Bridge Gain Test.

6.2.1.4.10.1 Press and hold IRIG GAIN pushbutton on G&N Indicator Control Panel. The IMU TEMP condition lamp shall be lighted.

6.2.1.4.10.2 The IRIG Temperature Indicating Bridge Amplifier output shall be 127.9°F to 129.1°F (CG 2301). Record indication of IRIG TEMP as displayed on CRT. Release IRIG GAIN pushbutton.

6.2.1.4.11 PIPA Temperature Bridge Calibration Test.

6.2.1.4.11.1 Press and hold ZERO pushbutton on the G&N Indicator Control Panel.

6.2.1.4.11.2 The PIPA Temperature Indicating Bridge Amplifier output shall be 128.9°F to 131.1°F (CG 2300). Record indication of PIPA TEMP as displayed on CRT. Release ZERO pushbutton.

6.2.1.4.12 PIPA Temperature Bridge Gain Test.

6.2.1.4.12.1 Observe Heater Current (CG 2302) on CRT; Press and hold PIPA GAIN pushbutton on G&N Indicator Control Panel. Observe a change in Heater Current on CRT and record CRT indication of PIPA TEMP (CG 2300). Release PIPA GAIN pushbutton.

6.2.1.4.12.2 IMU TEMP condition lamp shall be lighted.

6.2.1.4.12.3 The PIPA Temperature Indicating Bridge Amplifier output shall be 134.4°F to 135.6°F.

6.2.1.4.12.4 Release PIPA GAIN pushbutton, and record indication of PIPA TEMP as displayed on CRT (CG 2300).

6.2.1.4.12.5 IMU TEMP condition shall not be lighted.

6.2.1.4.12.6 The PIPA Temperature Indicating Bridge Amplifier output shall be 128.5°F to 134.5°F.

6.2.1.4.12.7 After a minimum of two hours in the Standby Mode, the following temperatures and current shall be recorded

6.2.1.4.12.7.1 The IRIG Temperature shall be 128.5°F to 134.5°F (CG 2301).

6.2.1.4.12.7.2 The PIPA Temperature shall be 128.5°F to 134.5°F (CG 2300).

6.2.1.4.12.7.3 The Heater current shall be 0.75 to 1.60 amperes (CG 2302). (only when current is applied).

6.2.2 General Turn Off and Turn ON Procedures

NOTE: This procedure shall be utilized any time after performing 6.2.1, Standby Power On Test, and 6.2.4, Operate Power On Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced on other tests.

6.2.2.1 Turn OFF Procedure

CAUTION

This procedure must be followed in the order specified. Failure to adhere to this procedure may require recalibration of the inertial components.

6.2.2.1.1 Verify or place the TRANSFER switch on the IMU CONTROL Panel to the COMPUTER POSITION.

6.2.2.1.2 Enter the following values into K148 in the listed sequence:

a. Insert VERB 41 NOUN 20 and verify. Press the ENTER pushbutton.
b. Insert -09000 and verify. Press the ENTER pushbutton.
c. Insert +00000 and verify. Press the ENTER pushbutton.
d. Insert +05700 and verify. Press the ENTER pushbutton.

6.2.2.1.3 Verify that the COARSE ALIGN MODE lamp on the IMU CONTROL panel is the only MODE lamp that is lighted. Wait 60 seconds.
NOTE: Ignore PGNS CAUTION Alarm on Condition Annunciator panel.

6.2.2.1.4 Place the TRANSFER Switch on the IMU CONTROL to the MANUAL position.
NOTE: Ignore PROG ALARM and COMP FAIL alarms on LEB and MDC DSKY's. Press ERROR RESET pushbutton.

6.2.2.1.5 Set the following switches on the G&N Indicator Control Panel to the positions designated.

a. SLAVE TELESCOPE to STAR LOS

b. OPTICS MODE to ZERO OPTICS

c. CONTROLLER MODE to DIRECT

d. CONTROLLER SPEED to LO

e. POWER AND BRIGHTNESS to OFF

f. ATTITUDE IMPULSE ENABLE to OFF

g. IMU TEMP MODE to AUTO-OVERRIDE

6.2.2.1.6 Set the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OPEN position (breakers pulled out).

6.2.2.1.7 Set the G&N IMU, MNA and MN B breakers on the Right Hand Circuit Breaker Panel to OPEN position (breakers pulled out).

6.2.2.1.8 The BRIGHTNESS thumbwheel on AGC-DSKY-LEB (lower Equipment Bay) and AGC DSKY-MDC (Main Display Console) shall be decreased to its minimum brightness - OFF position. Set the IMU HTR MNA and MNB breakers off (breakers pulled out).

6.2.2.1.9 Set ICTC POWER ON-OFF switch to ON. Press ALARM RESET switch and verify ALARM RESET lamp is not lighted. Verify that the ICTC is supplying inertial component heater power to the G&N System as indicated by the PTC HEATER POWER lamp illuminated on the PTC. Verify the temperature is within 135±5.0°F and the current is within 1±0.75 amperes on the PTC meter.

6.2.2.1.10 Set the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF position (breakers pulled out).

6.2.2.1.11 Set the G&N LIGHTING AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF position (breakers pulled out).

6.2.2.2 Turn On Procedures

6.2.2.2.1 Set or verify the following switches on the G&N Indicator Control Panel to the positions designated.

a. SLAVE TELESCOPE to STAR LOS
b. OPTICS MODE to ZERO OPTICS
c. CONTROLLER MODE to DIRECT
d. CONTROLLER SPEED to LO
e. POWER AND BRIGHTNESS to OFF
f. ATTITUDE IMPULSE ENABLE to OFF
g. IMU TEMP MODE to AUTO OVERRIDE
h. CONDITION LAMPS to ON

6.2.2.2.2 Ensure that SYNC switch on the MDC Panel 25 is in the OFF position.

6.2.2.2.3 Ensure that interfacing systems EPS and ECS are turned on and operating properly.

6.2.2.2.4 Ensure that the TRANSFER switch on the IMU CONTROL panel is set to MANUAL position.

CAUTION

> The remaining procedure must be followed in the order specified. Failure to adhere to this procedure may require recalibration of the inertial components.

6.2.2.2.5 Energize the G&N Lighting AC 1 and AC 2 breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.2.2.6 Ensure that the AGC MODE switch is set to ON position.

6.2.2.2.7 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Ensure that the AGC +28 VDC discrete lamp on Event Module is lighted (CG 1523). Verify that the secondary AGC power supply voltages on the CRT, display the following requirements:

a. CG 1020 +13 VDC AGC Supply +11.7 to +14.3 VDC
b. CG 1030 + 3 VDC AGC Supply +1.88 to +4.12 VDC.

6.2.2.2.8 Disregard all alarm indications on the AGC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton. All computer alarms on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify register R1, R2, and R3 on the AGC DSKY's are cleared.

6.2.2.2.9 Set the computer display lights to minimum usable brightness by rotating the BRIGHTNESS thumbwheels on the LEB AGC DSKY and MDC AGC DSKY.

6.2.2.2.10 Energize the G&N IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).

6.2.2.2.11 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted (CG 1513).

6.2.2.2.12 Reset ICTC alarm if alarm indication is present. Reset ICTC alarm. Verify ICTC ON/OFF switch to ON position.

6.2.2.2.13 Obtain E. Memory Zeroing Tape No. F04C017-K00012-XX and load tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AGC memory locations.

6.2.2.2.14 Run the remaining portion of Tape No. F04C017-K00012-XX to initiate AGC Self Test. Wait approximately three minutes.

6.2.2.2.14.1 Verify FAILURE DETECT lamp on Event Module 4A3 is not lighted.

6.2.2.2.14.2 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT +1 and SCOUNT +2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67±2 seconds.

NOTE: The following condition must be observed before proceeding to 6.2.2.2.15.

a. Two hours must elapse after performing 6.2.2.2.10 if all of the following conditions cannot be met.
   1. The G&N System has not been moved.
   2. The IMU gimbals have been parked for 6.2.2.1.2 or equivalent.
   3. The IMU gimbals have not been parked for more than 5 days.
b. If all of the above conditions are met, it is then permissible to proceed to 6.2.2.2.15 after 15 minutes has elapsed.
c. If the IMU HTR and G&N COMPUTER MNA breakers have been off for less than two hours, a waiting period equal to the time off or 15 minute minimum shall be endured in the Standby mode.

6.2.2.2.15 After required warmup time has elapsed, set the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker panel to ON position (breakers pushed in). Press the COARS ALIGN pushbutton on the IMU Control Panel. Ensure that the IMU +28 VDC OPERATE (ON) lamp on Event Module is lighted. (CG 1503). Verify the value of CG 1500, IMU +28 V on the CRT (+24.5 to +30.5 VDC). The gimbal lock lamp on the Condition Annunciator be lighted.

6.2.2.2.16 Ensure that the IMU DELAY lamp on the Condition Light Annunciator Panel is lighted and the IMU DELAY lamp on Event Module is lighted (CG 5008).

NOTE: Perform 6.2.2.2.17 only if performance of 6.2.4, 6.2.10, 6.2.11, 6.2.12, 6.2.13, 6.2.20, and 6.2.21 is anticipated.

6.2.2.2.17 Set the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position (breaker pushed in). Ensure that the OPTX +28 VDC discrete lamp on Event Module is lighted. (CG 1533).

6.2.2.2.18 Verify the value CG 1530, OPTX +28V on the CRT (+25 to 30.8 VDC) * Verify that the secondary power supply voltages of the following signals as displayed on the CRT is as indicated in Table VI.

* Only if 6.2.2.2.17 is performed.

TABLE VI. SECONDARY POWER SUPPLY VOLTAGES

Meas. No.	Signal	Requirement
a. CG 1000	+120 VDC IRIG Supply	+112.0 to +146 VDC
b. CG 1003	+12 VDC IRIG Supply	+10.6 to +13.4 VDC
c. CG 1006	+32 VDC IRIG Supply	+25.5 to +35.5 VDC
d. CG 1010	+120 VDC PIPA Supply	+107 to +145 VDC
e. CG 1016	+32 VDC PIPA Supply	+25.5 to +35.5 VDC
f. CG 1101	-28 VDC ELECTRONICS	-21.3 to -33.7 VDC
g. CG 1201	IMU 28 V 800 CPS 1% 0°	+27 to +29 VRMS
h. CG 1202	IMU 28V 800 CPS 5%-90°	+26.1 to +29.9 VRMS
i. CG 1203	IMU 28V 800 CPS 5%-0°	+24.7 to +30.3 VRMS
j. CG 1204	CDU 28 800 CPS 5%-90°	+26.1 to +29.9 VRMS
k. CG 1301	IMU 2V 3200 CPS SUPPLY	2.8 to 4.2 VRMS
l. CG 1302	20V 3200 CPS SQ WAVE	+15.6 to +24.4 VRMS
m. CG 1400	IMU 2.5V 25.6 KC in ø	+2.1 to +2.9 VRMS
n. CG 1110	+2.5 VDC T/M REFERENCE	+2.45 to +2.55 VDC
* o. CG 1211	OPTX 28V 800 CPS 1%-0°	+27 to +29 VRMS
* p. CG 1212	OPTX 800 CPS 5%-90°	+26.1 to +29.9 VRMS
* q. CG 1401	OPTX 2.5V 25.6 KC in ø	+2.1 to +2.9 VRMS

6.2.2.2.19 Set the TRANSFER switch on the IMU CONTROL panel to COMPUTER.

6.2.2.2.20 Enter and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton to advance System to COARS ALIGN mode. The VERB-NOUN display on CRT shall flash and indicate 21-22.

* only if 6.2.2.2.17 is performed.

6.2.2.2.21 Enter and verify +00000 into K148 three times pressing the ENTER pushbutton on the K148 after each entry. The COARS ALIGN MODE lamp on the IMU CONTROL panel shall be the only MODE lamp that is lighted. The PGNS CAUTION lamp on the Condition Annunciator may be on.

6.2.2.2.22 Monitor the signals listed below on a CRT to ensure that the IMU is not in a Gimbal Lock pondition. The signal shall indicate no gimbal oscillation movement.

	Meas. No.	Signal	Requirement
a.	CG 5003	GIMBAL LOCK WARNING	OFF
b.	CG 2142	MG CDU 1X RES SINE	Not Oscillating
c.	CG 2143	MG CDU 1X RES COSINE	Not Oscillating

6.2.2.2.23 Monitor the signals listed below on the CRT to verify normal PIPA loop operation.

a.	CG 2002	X PIPA SG OUT QUAD	Less than 0.66 VRMS
b.	CG 2022	Y PIPA SG OUT QUAD	Less than 0.66 VRMS
c.	CG 2042	Z PIPA SG OUT QUAD	Less than 0.66 VRMS

6.2.2.2.24 Perform 6.2.6 G&N Operational Test

NUMBER	REVISION LETTER	PAGE

6.2.3 AGC Operational Test

NOTE: This test shall be performed only when IMU HTR and Computer powers are supplied. Test shall not be performed when IMU operate power is applied.

6.2.3.1 Verify IMU STANDBY power (including AGC operate power) is applied and IMU OPERATE power is not applied, and that AGC MODE switch is ON. (G&N IMU HTR MN A and MN B breakers engaged (breakers pushed in) computer MN A and MN B breakers engaged (breakers pushed in) IMU MN A and MN B breakers disengaged (breakers pulled out).

6.2.3.1.1 Set the TRANSFER switch in MANUAL position on the IMU Control Panel.

6.2.3.1.2 Using LEB AGC DSKY, enter VERB 36. Press ENTER pushbutton. Press ERROR RESET on the LEB DSKY.

6.2.3.2 AGC Interface Checks

6.2.3.2.1 Enter the following sequence into the LEB AGC DSKY to initiate the DSKY test:

a. VERB 57 ENTER

b. 00007 ENTER

6.2.3.2.2 Observe all 9's displayed in the MAJOR MODE, VERB, NOUN and R1, R2 and R3 character positions and that the UPTL lamp is lighted. At approximately 10 second intervals, the following is displayed in the above character positions except where noted.

a. 8's
b. 7's
c. 6's
d. 5's
e. 4's
f. 3's
g. 2's
h. 1's
i. 0's
j. all positions blank
k. MINUS signs in R1 R2 and R3
l. PLUS signs in R1 R2 and R3 with the PROGRAM ALARM, TM FAIL, KEY RELEASE, CHECK FAIL and momentarily COMPUTER ACTIVITY lamps lighted.
m. UPTL lamp not lighted

6.2.3.2.2.1 Press ERROR RESET and KEY RELEASE pushbuttons. The KEY RELEASE and AGC alarm lamps shall not be lighted.

6.2.3.2.3 DSKY Pushbutton Check

6.2.3.2.3.1 Enter VERB 25, NOUN 02 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.2 Enter 01775 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.3 Enter +00123 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.4 Enter -00456 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.5 Enter -00789 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.6 Verify that +00123 is displayed in R1, -00456 is displayed in R2 and -00789 is displayed in R3 in the LEB and MDC AGC DSKY's.

6.2.3.2.3.7 Enter VERB 05, NOUN 02 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.8 Enter 01775 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.9 The LEB and MDC AGC DSKY's shall indicate 00178 in R1, 77067 in R2, and 76352 in R3. Verify the displays.

6.2.3.2.3.10 Repeat 6.2.3.2.3.1 through 6.2.3.2.3.9 using the MDC AGC DSKY.

6.2.3.2.4 C-Relay Check

CAUTION

Ensure that the Mission Control Programmer circuit breakers AUX BUS A MCP1 and MCP2, AUX BUS B MCP1 and MCP2 and POST LDG MCP of the Auxiliary DC Power Control Box are in the OFF positions.

NOTE: ACCEL FAIL, IMU FAIL, CDU FAIL and ZERO ENCODER lamps on Condition Annunciator panel will light intermittently during this test. Ignore KEY RELEASE light until directed to press KEY RELEASE.

6.2.3.2.4.1 Enter the following sequence into MDC or LEB AGC DSKY to initiate the C-Relay Test:

a.	VERB 15 NOUN 01	ENTER
b.	00723	ENTER
c.	VERB 57	ENTER
d.	00006	ENTER

6.2.3.2.4.2 Press KEY RELEASE pushbutton after KEY RELEASE lamp lights. Rows R1, R2 and R3 shall display the contents of DSPTAB +11D, (R1), DSPTAB +12D, (R2), DSPTAB +13D, (R3).

6.2.3.2.4.3 The DSPTAB registers will count in the sequence 1, 2, 4, 10, 20, 40, 100, 200, 400, 1000, 2000, beginning with the register in R3, then R2 and finally R1. IN3 will then be displayed. Verify that the above sequence is followed throughout the test and that the final display of R3 is 00001 and IN3 register in R1 shall display one of the following: 0XXXX, 1XXXX, 2XXXX, and 3XXXX.

6.2.3.2.4.4 If an error exists, the PROGRAM ALARM lamp will be lighted and a VERB-NOUN display of 01-33 will flash and R1 on the CRT or DSKY will display 01103 or 41103 for multiple failures. Record.

6.2.3.3 AGC Alarms and Interrupt Test

NOTE: During the following test disregard AGC Alarm indications which are not noted on the test. After each Error Reset for a test sequence insure all alarm lamps are not lighted.

6.2.3.3.1 Obtain G&N Alarms and Interrupts Test Tape No. F04C017-K00020-XX and load the tape on TAPE READER.

6.2.3.3.2 Set the POWER/ON switch on the TAPE READER 4A4-A2 to ON. Perform the following steps on Console 4A4-A3 in sequence:

a. Press the TAPE/KEY indicator to TAPE
b. Press the FWD/REV indicator to FWD
c. Press the IND/CONT indicator to CONT
d. Press the LOAD/INH indicator to LOAD

6.2.3.3.3 Computer Activity

6.2.3.3.3.1 Press the RUN indicator switch on to RUN. Wait until tape stops.

6.2.3.3.3.2 Verify R1 indicates 00001 on CRT.

6.2.3.3.3.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.3.4 Verify that the COMPUTER ACTIVITY lamps on the MDC and LEB DSKY's and Event Module are lighted. The lamps shall remain lighted for approximately 10 seconds (CG 5021).

6.2.3.3.4 RUPT LOCK (Due to extended or infrequent interrupts)

6.2.3.3.4.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.2 Verify R1 indicates 00002 on CRT.

6.2.3.3.4.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.4 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.

6.2.3.3.4.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.6 Verify R1 indicates00003 on CRT.

6.2.3.3.4.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.8 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.

6.2.3.3.5 TC Trap (Due to constant TC instruction or an extended period without a TC instruction being generated)

6.2.3.3.5.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.2 Verify R1 indicates 00004 on CRT.

6.2.3.3.5.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.4 The TC TRAP alarm light shall be lighted. Verify indications on the LEB DSKY and Event Module (CG 5029). Press ERROR RESET pushbuttons.

6.2.3.3.5.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.6 Verify R1 indicates 00005 on CRT.

6.2.3.3.5.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.8 The TC TRAP alarm light shall be lighted. Verify indication on LEB DSKY and Event Module (CG 5029). Press ERROR RESET.

6.2.3.3.6 PGNS CAUTION alarm generated by Nightwatchman program alarm.

6.2.3.3.6.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.6.2 Verify R1 indicates 00006 on CRT.

6.2.3.3.6.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.6.4 Verify the PGNS caution lamp on Condition Annunciator panel and G&N Error lamp on Panel 10 light within 3 seconds after tape stops and that the lamps light for only 2 to 3 seconds. Press Error Reset pushbutton.

6.2.3.3.7 Check Fail indications.

6.2.3.3.7.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.7.2 Verify R1 indicates 00007 on CRT.

6.2.3.3.7.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.7.4 Verify CHECK FAIL alarm indications on LEB DSKY and Event Recorder (CG 5023) and the PGNS lamp is lighted.

6.2.3.3.7.5 Press ERROR RESET on DSKY.

6.2.3.3.8 Program Alarm indication

6.2.3.3.8.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.8.2 Verify R1 indicates 00008 on CRT.

6.2.3.3.8.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.8.4 Verify Program Alarm indication on LEB DSKY and Event Recorder (CG 5020) and that PGNS lamp is lighted.

6.2.3.3.8.5 Press ERROR RESET on DSKY.

6.2.3.3.9 TELEMETRY FAIL ALARM

6.2.3.3.9.1 Press RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.9.2 Verify that R1 displays 00009 on the CRT.

6.2.3.3.9.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.9.4 Verify that the TELEMETRY FAIL alarm is illuminated in the MDC and the LEB DSKY.

6.2.3.3.9.5 Verify that SEAL is indicated on the K-START module. Press ERROR RESET to clear AGC DSKY's.

6.2.3.3.9.6 Insert Verb 36 and ENTER into LEB DSKY. Insert VERB 21 NOUN 02 and ENTER into LEB DSKY. Insert 00041 and ENTER into LEB DSKY. Insert 00000 and ENTER into LEB DSKY.

6.2.3.3.10 **PARITY FAIL**

6.2.3.3.101 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.102 Verify that R1 indicates 00010 on CRT.

6.2.3.3.103 Press the RUN indicator on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.104 Verify that PARITY ALARM has been generated and displayed on the MDC and the LEB DSKY's and that the EVENT MODULE is lighted. Disregard all or any other alarm indications. Press ERROR RESET.

6.2.3.4 **BANK SUM TEST**

6.2.3.4.1 Press ERROR RESET pushbutton and enter VERB 36 into K148, press ENTER pushbutton. Press ERROR RESET pushbutton.

6.2.3.4.2 Enter VERB 56 into K-148, press ENTER pushbutton.

6.2.3.4.3 Verify R1 = R2 = 00002 on CRT.

6.2.3.4.4 Enter VERB 33 into K-148, press ENTER pushbutton.

6.2.3.4.5 Verify R1 = R2 = 000XX on CRT.

6.2.3.4.6 Repeat 6.2.3.4.4 and 6.2.3.4.5 until R1 = R2 = 00034.

6.2.3.4.7 Enter VERB 34 into K-148, press ENTER pushbutton.

6.2.4 Operate Power on and Power Supply Test

CAUTION

a. Insure that the SYNC switch on MDC panel 25 is in the OFF position.

b. The sequence specified in steps 6.2.4.1 through 6.2.4.10.4 must be adhered to. Deviation may necessitate recalibration of inertial components.

6.2.4.1 G&N breakers on the Right Hand Circuit Breaker Panel shall be in the following positions:

a. COMPUTER MN A and MN B breakers ON (Breakers pushed in).
b. IMU HTR MN A and MN B breakers ON (Breakers pushed in).
c. IMU MN A and MN B breakers OFF (Breakers pulled out.)
d. OPTICS MN A and MN B breakers OFF (Breakers pulled out).
e. LIGHTING AC1 and AC2 breakers ON (Breakers pushed in).
f. G&N LIGHTING toggle switch in AC1 (up).

6.2.4.2 The TRANSFER switch on the IMU CONTROL Panel shall be in MANUAL position.

6.2.4.3 The AGC MODE switch on AGC shall be set to ON position.

6.2.4.4 Switches and selectors on the G&N Indicator Control panel shall be set to the following positions:

a. SLAVE TELESCOPE to STAR LOS
b. OPTICS MODE to ZERO OPTICS
c. CONTROLLER MODE to DIRECT
d. CONTROLLER SPEED to LO
e. POWER and BRIGHTNESS to OFF
f. ALTITUDE IMPULSE ENABLE to OFF
g. PANEL BRIGHTNESS to maximum increase
h. IMU TEMP MODE to AUTO OVERRIDE

6.2.4.5 IMU Operate Power

NOTE: Prior to switching to IMU Operate,
ensure that requirements of 6.1.1.2
and 6.1.1.2.1 have been met.

6.2.4.5.1 Set up the Analog Recorder 4A3-A2 and the switches on the Analog Select Panel 4A3-A3 to monitor the following signals:

a.	CG 2206	IGA CDU 1X RES ERR
b.	CG 2236	MGA CDU 1X RES ERR
c.	CG 2266	OGA CDU 1X RES ERR

6.2.4.5.2 Start analog recorder using a chart speed of 5 MM/SEC. Start Event Recorder chart drive using chart speed of 10 MM/SEC. Prepare to mark the strip chart on analog recorder at the time IMU DELAY lamp extinguishes.

6.2.4.5.3 With the IMU in Standby Mode, the IMU Operate Power shall be applied by actuating the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breaker-pushed in). Press COARS ALIGN mode lamp on IMU Control Panel.

6.2.4.5.4 IMU DELAY lamps on the Condition Annunciator Panel, and Event Module shall be lighted when IMU Operate Power is applied (CG 1503). The IMU DELAY lamp shall extinguish after a time delay of 100 ± 10 seconds (CG 5008).

6.2.4.5.5 The COARS ALIGN (Coarse Align), MODE lamp on the IMU CONTROL Panel shall be lighted when IMU Operate power is switched on. After a time delay of 100 ± 10 seconds, the COARS ALIGN lamp shall remain lighted. The gimbal lock lamp on Condition Annunciator panel may be lighted.

6.2.4.5.6 After the IMU DELAY lamps go out, mark the strip chart, stop the Event Recorder, and record the time at which the IMU DELAY lamp is extinguished.

6.2.4.5.7 Stop the Analog Recorder 4A3-A2. Record the time at which the initial transient on OGA CDU 1X Resolver Error signals occurred from Analog Recorder 4A3-A2.

6.2.4.5.8 Determine elapsed time between OGA 1X resolver initial transient and IMU DELAY lamp going out from the recorders.

6.2.4.5.9 Just prior to the time when the IMU DELAY lamp extinguishes, the Outer, Middle, and Inner IMU-CDU 1X Resolver nulls shall be less than 0.600 VRMS (CG 2266, CG 2236, and CG 2206). Record the amplitude of all CDU 1X resolver signals from Analog Recorder 4A3-A2.

6.2.4.5.10 IMU +28 VDC OPERATE discrete shall be issued (CG 1503) by observing that the IMU OPERATE lamp on Event Module is lighted. Record the value of CG 1500, IMU +28V on the CRT (+24.5 to 30.5 VDC).

6.2.4.6 Optics Power On

6.2.4.6.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.4.6.2 OPTICS +28 VDC discrete shall be issued (CG 1533) by observing that the OPTICS lamp on Event Module is lighted. Record the value of CG 1530, OPTX +28V on the CRT (+24.5 to 30.5 VDC).

6.2.4.6.3 Verify that the ZERO ENCODER on the Condition Annunciator Panel is lighted for no more than 90 seconds after Optics Power Turn On.

6.2.4.6.4 The SHAFT ANGLE and TRUNNION ANGLE adjacent to the Scanning Telescope eyepiece shall be 0.0 ± 1.0 degree.

6.2.4.7 Set TRANSFER switch on the IMU CONTROL panel to COMPUTER. Disregard all computer alarms. Enter VERB 36, press ENTER pushbutton, then press ERROR RESET pushbutton. All alarms shall clear.

6.2.4.8 Enter and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton to advance system to COARSE ALIGN under AGC control. The VERB NOUN display on CRT shall flash and indicate 21-22.

6.2.4.9 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton after each entry. The COARSE ALIGN mode lamp on the IMU CONTROL panel shall be the only MODE lamp lighted. Insure that gimbal Lock lamp on Condition Annunciator panel is not lighted.

6.2.4.10 Secondary Power Supply Voltages, Noise Peaks and Phese Difference

NOTE: Ensure that the IMU Operate Power has been on for a minimum of 15 minutes before proceeding with this test.

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6.2.4.10.1 Record the secondary power supply voltages of the following signals displayed on the CRT.

Item No.	Measurement No.	Signal	Requirement
a.	CG 1000	+120 VDC IRIG SUPPLY	+112 to +146 VDC
b.	CG 1003	+ 12 VDC IRIG SUPPLY	+10.6 to +13.4 VDC
c.	CG 1006	+ 32 VDC IRIG SUPPLY	+25.5 to +35.5 VDC
d.	CG 1010	+120 VDC PIPA SUPPLY	+107 to +145 VDC
e.	CG 1016	+ 32 VDC PIPA SUPPLY	+25.5 to +35.5 VDC
f.	CG 1020	+ 13 VDC AGC SUPPLY	+11.7 to +14.3 VDC
g.	CG 1030	+ 3 VDC AGC SUPPLY	+1.88 to +4.12 VDC
h.	CG 1101	- 28 VDC SUPPLY	-33.7 to -21.3 VDC
i.	CG 1110	+2.5 VDC TM BIAS	+2.45 to +2.55 VDC
j.	CG 1301	IMU 2V 3200 CPS SUPPLY RMS	2.8 to 4.2 VRMS
k.	CG 1400	IMU 2V 25.6 KC SUPPLY IN PH	+2.1 to +2.9 VRMS
l.	CG 1401	OPTX 2V 25.6 KC SUPPLY IN PH	+2.1 to +2.9 VRMS
m.	CG 1201	IMU 28V .8 KC 1 PCT 0 Deg SUP RMS'	+27 to +29 VRMS
n.	CG 1202	IMU 28V .8KC 5 PCT 90 Deg SUP RMS	+26.1 to +29.9 VRMS
o.	CG 1203	IMU 28V .8 KC 5 PCT 0 Deg SUP RMS	+24.7 to +30.3 VRMS
p.	CG 1204	CDU 28V .8 KC 5PCT 90 Deg SUP RMS	+26.1 to +29.9 VRMS
q.	CG 1211	OPTX 28V .8 KC 1 PCT 0 Deg SUP RMS	+27 to 29 VRMS
r.	CG 1212	OPTX 28V .8 KC 5 PCT -90 Deg SUP RMS	+26.1 to +29.9 VRMS
s.	CG 1302	20V 3.2 KC SQ WAVE SUPPLY RMS	+15.6 to +24.4 VRMS

6.2.4.10.2 Record the noise peaks of the following signals displayed on the CRT:

Item No.	Meas'mt No.	Signal	Requirement
a.	CG 1001	+120 VDC IRIG NOISE RMS	Less than ±1.00VRMS
b.	CG 1011	+120 VDC PIPA NOISE RMS	Less than ± 1.0 VRMS
c.	CG 1021	+ 13 VDC AGC NOISE RMS	Less than 0.65 VRMS
d.	CG 1031	+ 3 VDC AGC NOISE RMS	Less than 0.65 VRMS
e.	CG 1501	+ 28 VDC No. 1 NOISE RMS	Less than ± 0.70 VRMS
f.	CG 1511	+ 28 VDC No. 2 NOISE RMS	Less than ± 0.70 VRMS
g.	CG 1521	+ 28 VDC No. 3 NOISE RMS	Less than ± 0.70 VRMS
h.	CG 1531	+ 28 VDC No. 4 NOISE RMS	Less than ± 0.70 VRMS

6.2.4.10.3 Record the phase difference of the following signals displayed on the CRT:

a.	CG 1206	PH DIF IMU 1% 0°, IMU 5% 90°	-77.0 to -103°
b.	CG 1207	PH DIF IMU 5% 0°, IMU 5% 90°	-77.0 to -103°
c.	CG 1306	PH DIF IMU 2V 3.2KC AGC SYNC	-12.5 to +12.5°
d.	CG 1209	PH DIF IMU 1% 0° CDU 5% 90°	-77 to -103°
e.	CG 1220	PH DIF IMU 1% 0° OPTX 1% 0°	-12.5 to +12.5°
f.	CG 1402	PH DIF IMU 25.6KC OPTX 25.6KC	-32 to +32°
g.	CG 1216	PH DIF OPTX 1% 0° OPTX 5% 90°	-77 to -103°

6.2.4.10.4 The noise peaks of the following signals are demonstrated on the event lights when the peak voltage exceeds 5 volts and is present for more than one microsecond.

			Event Module
a.	CG 1022	+13 VDC AGC NOISE PEAK	4A3-A5
b.	CG 1032	+ 3 VDC AGC NOISE PEAK	4A3-A5
c.	CG 1502	+28 VDC No. 1 NOISE PEAK	4A3-A5
d.	CG 1512	+28 VDC No. 2 NOISE PEAK	4A3-A5
e.	CG 1522	+28 VDC No. 3 NOISE PEAK	4A3-A5
f.	CG 1532	+28 VDC No. 4 NOISE PEAK	4A3-A5

6.2.4.10.5 Optics power shall be removed by actuating the G&N OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel to off. (breakers pulled out)

6.2.4.10.6 Perform 6.2.6 G&N Operational Test.

6.2.5 GIMBAL LOCK TEST

6.2.5.1 Proceed with this test if 6.2.4, Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn on Procedure.

6.2.5.2 Insert and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton.

6.2.5.3 Insert and verify +00000 into K148 two times, pressing ENTER pushbutton after each insertion.

6.2.5.4 Insert and verify +05400 into K148. Press ENTER pushbutton. Wait 60 seconds.

6.2.5.5 Verify that GIMBAL LOCK lamp on Condition Annunciator panel is not lighted.

6.2.5.6 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.

6.2.5.7 Insert and verify +06500 into K148. Press ENTER pushbutton. Wait 60 seconds.

6.2.5.8 Verify that GIMBAL LOCK lamp on Condition Annunciator panel is lighted.

6.2.5.9 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.

6.2.5.10 Insert and verify +18000 into K148. Press ENTER pushbutton and observe that GIMBAL LOCK lamp remains lighted while IMU and CDU are driving to 180 degrees. Wait 60 seconds.

6.2.5.11 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.

6.2.5.12 Insert and verify +29500 into K148. Press ENTER pushbutton and observe that GIMBAL LOCK lamp remains lighted while IMU and CDU are driving to 295 degrees. Wait 60 seconds.

6.2.5.13 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.

6.2.5.14 Insert and verify +30600 into K148. Press ENTER pushbutton.

6.2.5.15 Verify that the GIMBAL LOCK lamp on Condition Annunciator panel is not lighted.

6.2.5.16 Insert and verify the following into K148:

a.	VERB 41 NOUN 20	ENTER
b.	+00000	ENTER
c.	+00000	ENTER
d.	+00000	ENTER

6.2.5.17 Verify COARS ALIGN mode lamp is lighted.

6.2.6 G&N Operational Test

Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.6.1 Initial Conditions

6.2.6.1.1 Ensure that the AGC MODE switch is in the ON position.

6.2.6.1.2 Verify that TRANSFER switch on IMU CONTROL Panel is in COMPUTER position and that the AGC Mode switch is in the ON position.

6.2.6.2 Initiation

6.2.6.2.1 Insert the following sequence into K148.

a) VERB 57 ENTER
b) 00004 ENTER

6.2.6.2.2 Verify that the PROGRAM display on CRT indicates 07.

NOTE: During this portion of the test, the G&N System is exercised through its modes and the MODE lamp displays will change automatically in the following sequence: ZERO ENCODE, FINE ALIGN, ATTITUDE CONTROL, COARSE ALIGN and FINE ALIGN. If the PROGRAM display on the LEB DSKY does not change, proper mode changing is occurring.

6.2.6.2.3 After approximately 10 minutes, the value of the gravity vector in CM/SEC^2 shall be displayed in R1 and R2 on CRT. Record these values. Verify VERB 06, NOUN 66 are flashing near end of 10 minute period.

6.2.6.2.4 R1 is the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be +980.00000 ± 10.00000 CM/SEC^2.

6.2.6.2.5 Enter VERB 33 into K148. Press the ENTER pushbutton. Verify that VERB 06 and NOUN 66 are flashing.

6.2.6.2.6 The value of the horizontal earth rate shall be displayed in R1 and R2 on CRT. Record these values.

6.2.6.2.7 R1 is the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between R1 and R2. The horizontal earth rate shall be 00000.87864±0.10000 ERU (Earth Rate Unit).

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 34 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.4 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.5 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.6 Verify COARSE ALIGN is the only Mode lamp lighted.

6.2.7 IMU Temperature Control Test

6.2.7.1 Proceed with this test if test in 6.2.4, Operate Power On Test, has been completed and system operation has not been interruped. If system operation has been interruped, perform 6.2.2.2 before proceeding. The signal values of this test are to be recorded as displayed on the CRT. The following Measurement Numbers and Signals are inserted here as a convenience for later reference.

ITEM NO.	MEASUREMENT NO.	SIGNAL
a.	CG 2300	PIPA TEMP
b.	CG 2301	IRIG TEMP
c.	CG 2302	HEATER CURRENT
d.	CG 2303	BLOWER CURRENT
e.	CG 2304	T.C. BRIDGE SUPPLY

6.2.7.1.1 Insure that the following Ground Support Equipment (GSE), identified in 4.1, is installed and connected before proceeding with 6.2.7.2

a. Digital Signal Conditioning and Multiplexing Unit, Model No. C14-211.

b. G&N Signal Conditioning and Switching Matrix Unit (DTMS)

c. Carry-On Command Stimuli Unit (ACE-S/C Digital Test Command System DTCS)

d. ACE-SC Carry-On Junction Box

e. PSA Adapter Module

f. External Digital Test Command Unit

g. Data Interleaver System

h. Electrical Cable Set

6.2.7.2 Set the TRANSFER switch on the IMU CONTROL panel to MANUAL. Reset any AGC alarms by entering VERB 36, pressing ENTER pushbutton then pressing ERROR RESET pushbutton on LEB AGC DSKY.

6.2.7.3 Place the G&N IMU to Standby Mode by positioning the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (Breakers pulled out). Note that the IMU OPERATE discrete lamp on Event Module is not lighted.

6.2.7.4 Place the IMU TEMP MODE selector on the G&N Indicator Control Panel to AUTO OVERRIDE position.

6.2.7.5 With the IMU in the Standby Mode, wait 30 minutes and record the values of the following signals as displayed on CRT. The BLOWER CURRENT will not be on at this time (CG 2303).

Measurement No.	Signal	Requirements
a. CG 2300	PIPA TEMP	128.0°F to 134.5°F
b. CG 2301	IRIG TEMP	128.0°F to 134.5°F
c. CG 2302	HEATER CURRENT	0.75 to 1.60 AMP
d. CG 2304	T.C. BRIDGE SUPPLY	18.4 to 25.5 VDC

6.2.7.6 Place the G&N IMU to Operate Mode by setting the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position. After the IMU DELAY lamp goes out, press the COARS ALIGN pushbutton on the IMU CONTROL panel. The COARS ALIGN lamp is the only MODE lamp that is lighted. Record the time when IMU Operate power is applied.

6.2.7.7 Place the TRANSFER switch on the IMU control panel to COMPUTER.

6.2.7.8 Enter VERB 40, NOUN 20 into K148. Press ENTER pushbutton. Wait 90 seconds.

6.2.7.9 Enter VERB 41, NOUN 20 into K148. Press ENTER pushbutton.

6.2.7.10 Enter +00000 into K148 three times, pressing ENTER pushbutton after each entry. COARS ALIGN mode lamp on the IMU CONTROL panel shall be the only MODE lamp lighted.

6.2.7.11 Proportional Mode

6.2.7.11.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to PROPORTIONAL position.

6.2.7.11.2 Thirty minutes after IMU Operate Mode, the signal values of 6.2.7.1 shall be as follows:

a. The PIPA temperature shall be 129.0° to 131.0°F and the IRIG temperature shall be 133.0 to 136.0°F (CG 2300, CG 2301).

b. The Heater current shall be 0.55 to 1.41 amperes (when current is applied) (CG 2302).

c. The Blower current shall be 0.15 to 0.55 amperes (when current is applied) (CG 2303).

d. The Temperature Control Bridge supply shall be 18.4 to 25.4 VDC (CG 2304).

6.2.7.11.3 After two hours from time IMU MN A and MN B power was applied, the following values shall be present.

a. The PIPA Temperature shall be 129.5 to 131.0°F and the IRIG temperature shall be 133.0 to 136.0°F (CG 2300, CG 2301).

b. The Heater current shall be 0.55 to 1.41 amperes (when current is applied) (CG 2302).

c. The Blower current shall be 0.15 to 0.55 amperes (when current is applied)(CG 2303).

6.2.7.11.4 Set IMU TEMP MODE selector to AUTO OVERRIDE. Monitor at 5-minute intervals the values of signals a and b in 6.2.7.1 for 15 minutes (3 monitor periods). Record the maximum values of each signal during this time. These values shall be within those requirements listed in 6.2.7.11.3.

6.2.7.12 Backup Mode

6.2.7.12.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to BACKUP position. The IMU TEMP lamp on Condition Annunciator Panel will cycle on and off.

Wait 60 minutes and record the following values:

a. The PIPA temperature shall be 129.5 to 133.0°F.
b. The IRIG temperature shall be 134.5 to 137.5°F.

6.2.7.12.2 Monitor at 5 minute intervals, the values of signals a and b in 6.2.7.1. At the end of 15 minutes (3 monitor periods) record the maximum and minimum values of these signals. The values shall be within those requirements listed in 6.2.7.12.1.

6.2.7.13 Emergency Mode

6.2.7.13.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to EMERGENCY position. The IMU TEMP lamp on the condition annunciator panel will be on during EMERGENCY MODE.

6.2.7.13.2 After the IMU has been switched to EMERGENCY control for a minimum of one hour, the IRIG temperature shall remain within ± 2.0F of its value in 6.2.7.11.3 and PIPA temperature shall remain within ± 2.0 F of its value in 6.2.7.11.4 as indicated on the CRT.

6.2.7.14 Auto Override Mode

6.2.7.14.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to AUTO OVERRIDE position. Wait 30 minutes. The signal values shall be as follows: Record the values.

a. The PIPA Temperature shall be within 129.0 to 131.0°F and the IRIG temperature shall be within 133.0 to 136.0°F (CG 2300, CG 2301).

6.2.8 AGC Clock Frequency and Alignment Tests

6.2.8.1 AGC Clock Frequency Test

6.2.8.1.1 Perform this test if 6.2.4, Operate Power On Test or 6.2.2.2, Power On Procedure has been completed and G&N System Operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Power On Procedure before proceeding.

6.2.8.1.2 Ensure that the AGC has been operating for at least 10 minutes before this test.

6.2.8.1.3 Ensure that the 5245L ELECTRONICS power has been applied for the length of time as required by the manufacturers' specifications.

6.2.8.1.4 Verify that the coax PIPA FREQ MON is connected between Signal Test Point and the AC Signal Input of 5245L ELECTRONIC COUNTER.

6.2.8.1.5 Set the switches on the 5245L ELECTRONIC COUNTER to the following positions:

6.2.8.1.5.1 Set the Preset Counter to indicate 96000.

6.2.8.1.5.2 Set TIME BASE to ms

6.2.8.1.5.3 Set FUNCTION to TIME INTERVAL

6.2.8.1.5.4 Set MODE to NX PERIOD

6.2.8.1.5.5 Set SENSITIVITY to 1

6.2.8.1.6 Rotate the ACCEL MON selector switch on the PSA Adapter Module to ACE position.

6.2.8.1.7 Enter the code 1000 into R-START 4A4-A5-R147. The upper portion of the indicator shall be illuminated. Press the XEQ/SEAL pushbutton to switch the IMU 3.2 KC power supply on to the hardline. Voltage shall be available on the vertical input to the PIPA Scope 4A4-A1.

6.2.8.1.8 Each count cycle should last approximately 30 seconds. Adjust display time to permit recording the display on the E-PUT.

6.2.8.1.9 Repeat the counting cycle 10 times and record the results of the 10 counting cycles. Calculate the average time per cycle for the 10 counting cycles. Record the average time per cycle.

6.2.8.1.10 The average time shall be not greater than

$$\frac{96000}{3199.9922} = 30.0000731 \text{ seconds, nor less than}$$

$$\frac{96000}{3200.0078} = 29.9999269 \text{ seconds}$$

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6.2.8.2 AGC Clock Alignment Test

6.2.8.2.1 Ensure that ACE Uplink Alternate Load 2 is loaded in ACE computer.

6.2.8.2.2 Ensure that the UPTEL switch on MDC DSKY is in ACCEPT position and that CRT indicates

ACCEPT UPLINK - ON
CHECK FAIL - OFF
T/M FAIL - OFF

6.2.8.2.3 Ensure that TM FAIL and CHECK FAIL indications on DSKY are off.

6.2.8.2.4 Set R144 to 0001 and execute, observe that CRT indicates TIME ERROR as blank.

6.2.8.2.5 Set 7000035020 into C156 to insert K-FACT. Execute.

6.2.8.2.6 Set 7100000000 into C156 to insert TEPOCH. Execute.

6.2.8.2.7 Obtain Range Time in Hrs, Mins, Secs, (2 times).

6.2.8.2.8 Add 5 minutes to Range Time and insert 90 XX (HRS) XX (MIN'S) XXX (SEC's) into C156. Execute.

6.2.8.2.9 Set 91 + 0000000 into C156 to insert AGC RESET time. Execute.

6.2.8.2.10 Before Range Time +5 minutes occurs, set 0001 into R152 and execute.

6.2.8.2.11 Verify that CRT indication of TIME ERROR is blank.

NOTE: If TIME ERROR 1 is present, repeat all preceding steps of AGC Clock Alignment.

6.2.8.2.12 Set R152 to 0000 and execute.

6.2.8.2.13 Set R152 to 0010 and execute. Record CRT indication of DELTA TIME. Verify that CRT indication of TIME ERROR is blank.

6.2.8.2.14 Set R152 to 0000 and execute.

6.2.8.2.15 Set R152 to 0100 and execute. Verify that CRT indication of TIME ERROR is blank.

6.2.8.2.16 Set R152 to 0000 and execute.

6.2.8.2.17 Set R152 to 0010 and execute. Record CRT indication of DELTA TIME. DELTA TIME shall be 000 HRS 00 MIN 000.000 SEC ± 0.01 sec.

6.2.8.2.18 Set R152 to 0000 and execute.

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6.2.9 G&N Panel Brightness and Lamp Test

6.2.9.1 Panel Brightness Control Operation - the PANEL BRIGHTNESS thumbwheel shall be exercised to demonstrate the capability of controlling the illumination of the following lamps:

a. Optical Reticles

b. Telescope Angle Readouts

c. IMU-CDU Differance Display

d. COARS ALIGN MODE lamp on IMU CONTROL Panel

e. CDU Displays

6.2.9.2 Mode Indication Lamp Check - The CHECK MODE lamps pushbutton shall be depressed and cause the following MODE lamps to be illuminated:

a. ZERO ENC

b. COARS ALIGN

c. FINE ALIGN

d. CDU MAN

e. ATT CONT

f. ENTRY

g. TRACKER

6.2.9.2.1 Release the CHECK MODE lamps pushbutton. All MODE lamps except COARS ALIGN lamp on the IMU CONTROL Panel shall be extinguished.

6.2.9.3 Condition indication Lamp Check. - Set CONDITION LAMP switch ON/OFF to ON position. The CHECK CONDITION lamps pushbutton shall be depressed and shall cause the following lamps to be illuminated:

a. PGNS

b. AGC PWR FAIL

c. IMU FAIL

d. ACCEL FAIL

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e. G&N FAIL

f. GIMBAL LOCK

g. IMU TEMP

h. ZERO ENCODER

i. IMU DELAY (This lamp will not illuminate in Systems Standby mode)

j. MASTER ALARM

k. [illegible]

6.2.9.3.1 Release CHECK CONDITION lamps pushbutton. All condition lamps on the Condition Annunciator Panel shall be extinguished.

6.2.9.4 AGC Display Indication - On depression of Test Alarm Switch, the proper operation of the AGC alarm circuitry will be demonstrated by the illumination of the following lamps:

a. RUPT LOCK

b. TC TRAP

c. COUNTER FAIL

d. PARITY FAIL

e. PGNS [illegible]

6.2.9.4.1 Press ERROR RESET pushbutton. All alarm lamps on the AGC DSKY shall be extinguished. The IMU DELAY lamp lights for 100 seconds when system is in Operate mode.

6.2.9.5 Check Coolant - The CHECK COOLANT pushbutton shall be depressed and shall cause illumination of the area in which the coolant quick disconnects are contained. Verify that the quick disconnects are not leaking and the metallic areas of the quick disconnects, visible through the Port Holes, have no droplets of condensation that might drip. [illegible] system is [illegible]

6.2.9.5.1 Release CHECK COOLANT lamp pushbutton. The COOLANT lamp shall not be lighted.

6.2.10 Optics Servo Tests

6.2.10.1 Proceed with this test if 6.2.4, Operate Power-On Test, has been completed, and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2., Turn-On Procedure, before proceeding.

6.2.10.2 Ensure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker panel are pushed in. Insure that the TRANSFER switch on the IMU Control Panel is set to COMPUTER.

6.2.10.3 Ensure that the SLAVE TELESCOPE switch on the G&N Indicator Control Panel is set to STAR LOS, the TRACKER POWER switch is set to OFF and the TRACK pushbutton is not illuminated. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

NOTE: If the G&N System is in IMU Operate Mode, ensure that the system is in Coarse Align Mode under AGC control.

6.2.10.4 Trunnion CDU Servo Loop Check

6.2.10.4.1 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to MED and the CONTROLLER MODE switch to DIRECT.

6.2.10.4.2 Enter the code 2019000000 into the C-START module. Press the XEQ/SEAL pushbutton to call CG 3206 TRUNNION CDU TACH OUTPUT to the high rate channel of the Analog Recorder 4A1-A03.

6.2.10.4.3 Set up to monitor the following signals on the Analog Recorder 4A3-A02:

CG 3104	SXT TRUN MDA INPUT INPHASE
CG 3114	SXT SHAFT MDA INPUT INPHASE

6.2.10.4.4 Start the Analog Recorders at 5 mm/sec. Move and hold the OPTICS CONTROL STICK to its upper limit not longer than 10 sec. Release the control stick and stop the Analog Recorders. Record the maximum values of CG 3206, TRUNNION CDU TACH OUTPUT and CG3104, SXT TRUN MDA INPUT INPHASE.

6.2.10.4.5 The maximum value of CG 3206, TRUNNION CDU TACH OUTPUT, shall be 1.05 ± 0.20 VRMS. The maximum value of CG 3104, SXT TRUN MDA INPUT INPHASE, shall be 1.25 ± 0.20 VRMS.

[illegible]

6.2.10.5 **Shaft CDU Servo Loop Check**

6.2.10.5.1 Enter the code 2020000000 into the C-START module. Press the XEQ/SEAL pushbutton to call CG 3226, SHAFT CDU TACH OUTPUT, to the high rate channel of Analog Recorder 4A1-A03.

6.2.10.5.2 Set the CONTROLLER SPEED selector on the G&N Indicator Control Panel to MED.

6.2.10.5.3 Place the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER has extinguished, place the selector to MANUAL.

6.2.10.5.4 Start the Analog Recorders 4A1-A03 and 4A3-A02 at 5 mm/sec. Move and hold the OPTICS CONTROL STICK against its right limit for not longer than 10 sec. Release the control stick and stop the Analog Recorders. Record the maximum values of CG 3226, SHAFT CDU TACH OUTPUT and CG 3114, SXT SHAFT MDA INPUT INPHASE.

6.2.10.5.5 The maximum value of CG 3226, SHAFT CDU TACH OUTPUT, shall be 1.05 ±0.20 VRMS. The maximum value of CG 3114, SXT SHAFT MDA INPUT INPHASE, shall be 1.25±0.20 VRMS.

6.2.10.6 **Optics Time to Zero**

6.2.10.6.1 Set selector on G&N Indicator Control Panel to ZERO OPTICS. Wait 90 sec. Set selector on G&N Indicator Control Panel to MANUAL.

6.2.10.6.2 Set up the Analog Recorder to monitor the following signals at a chart speed of 10 mm/sec. Do not start recorder at this time.

	Analog Recorder
a. CG 3226, SHAFT CDU TACH OUTPUT	4A3-A2-2-3
b. CG 3206, TRUNNION CDU TACH OUTPUT	4A3-A2-7-2
c. CG 3124, SCT SHAFT TACH FEEDBACK	4A3-A2-3-2
d. CG 3134, SCT TRUNNION TACH FEEDBACK	4A3-A2-4-3

6.2.10.6.3 Using the control stick, drive the 2X Trunnion CDU in a positive direction to 180.0XX degrees and the Shaft CDU to 270.0XX degrees.

6.2.10.6.4 Start the Analog Recorder and set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS.

6.2.10.6.5 When all signals have reached a steady state value, set the attenuation on the Analog Recorder to the lowest usable ranges.

6.2.10.6.6 After 5 seconds, stop the recorder. Record the elapsed time between steady state nulls on all signals listed in 6.2.10.6.2. The elapsed time between steady state nulls shall be less than 27 sec. for signals a) and c) and less than 18 sec. for signals b) and d).

6.2.10.6.7 Record the level of the CG 3141 TRUNNION CDU 16X RESOLVER and CG 3211, SHAFT CDU 16X RESOLVER signals on the CRT. The absolute value of these signals shall be 0.005 VRMS.

6.2.10.6.8 Record the SHAFT and 2X TRUNNION CDU indications. The 2X TRUNNION and SHAFT angle readouts shall be 0.000 ± 0.006 degrees.

6.2.10.7 AGC Mode Indication and Control

6.2.10.7.1 Enter and verify VERB 16 and NOUN 55 into K148. Press the ENTER pushbutton. The AGC display R1 and R2 on the CRT shall be all zeros.

6.2.10.7.2 Enter and verify VERB 11 (MONITOR) and NOUN 01 (ADDRESS) into K148. Press the ENTER pusbbutton.

6.2.10.7.3 Enter address 00007 into K148. Press the ENTER pushbutton. The AGC display on the CRT shall indicate the contents of IN3 in R1 to be X4XXX.

6.2.10.7.4 Set the OTPICS MODE selector on the G&N Indicator Control Panel to MANUAL. The AGC display on the CRT shall indicate contents of IN3 in R1 to be X0XXX.

6.2.10.7.5 Set the OPTICS MODE selector on the G&N Indicator Control Panel to COMPUTER. The AGC display of Mode Register IN3 in R1 shall indicate 3XXXX or 7XXXX on CRT.

6.2.10.7.6 Enter the following sequence into the K148 and verify:

a. VERB 21, NOUN 01 ENTER
b. 00724 ENTER
c. 40000, ENTER
d. VERB 41, NOUN 55, ENTER
e. +03000, ENTER
f. +15000, ENTER

6.2.10.7.7 Verify that the SHAFT and the 2X TRUNNION CDU move to 30.0 degrees.

6.2.10.7.8 Enter the following sequence into the K148:

a. VERB 21, NOUN 01, ENTER
b. 00724 ENTER
c. 40001 ENTER

6.2.10.7.9 Verify that the SHAFT and 2X TRUNNION CDU readouts move to 0.000 ± 0.006 degrees and stop.

6.2.10.7.10 Enter and verify VERB 16, NOUN 55 into K148. Press ENTER pushbutton. The AGC display of Registers R1 and R2 on the CRT shall be all zeros.

6.2.10.7.11 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return selector to MANUAL.

6.2.11 Optics Slew Rate Test

6.2.11.1 Proceed with this test if 6.2.4, Operate Power-On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn-On Procedure, before proceeding.

6.2.11.2 Insure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breakers panel are pushed in. Insure that the TRANSFER switch on the IMU Control Panel is set to COMPUTER, and that the OPTICS MODE switch is set to DIRECT position.

6.2.11.3 Verify that the G&N System is in the Coarse Align Mode under AGC control. COARSE ALIGN MODE lamp is the only MODE lamp that is lighted.

6.2.11.4 Slew Rate - High Speed

6.2.11.4.1 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to HI.

6.2.11.4.2 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.4.3 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 00.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.4.4 before proceeding. Do not hold control stick at upper limit for more than ten seconds. Clear any indications on DSKY with "ERROR RESET" or "KEY RELEASE".

6.2.11.4.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately five seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick. Verify KEY RLSE is lighted add press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2, and R3, In a few seconds (approximately 10 seconds), the displays in R1, R2, and R3 change; record the second displays in R1, R2 and R3.

NOTE: The R1, R2, and R3 displays when the "MARK" pushbutton is pressed are as follows:
R1 is Shaft Angle as XXX.XX degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

NOTE: [illegible]

6.2.11.4.5 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.4.4 as Δ Trun, and Δ Time.

6.2.11.4.6 Compute and record the Trunnion slew rate as the ratio degree/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.4.7 The Trunnion slew rate shall be 9.0 ± 1.8 degrees/second.

6.2.11.4.8 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished, return selector to MANUAL position.

6.2.11.4.9 Record the SHAFT CDU and 2x TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.4.10 before proceeding. Do not hold control stick at right limit for more than ten seconds.

6.2.11.4.10 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately five seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

NOTE: The R1, R2, and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

6.2.11.4.11 Compute the respective differences between the R1 and R3 displays recorded in 6.2.11.4.10 as △Shaft and △ Time.

6.2.11.4.12 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.4.13 The Shaft slew rate shall be 17.0 ± 3.4 degrees/second.

6.2.11.5 Slew Rate - Medium Speed

6.2.11.5.1 Set up Analog Recorders to measure the following signals at the location specified:

a. CG 3141 TRUN CDU 16X RES ERROR 4A1-A3-7-0
b. CG 3120 SXT TRUN 1X RES ERROR 4A1-A2-8-0
c. CG 3211 SHAFT CDU 16X RES ERROR 4A3-A2-8-2

6.2.11.5.2 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to MED.

6.2.11.5.3 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.5.4 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.5.5 before proceeding. Do not hold control stick at upper limit for more than twenty seconds.

6.2.11.5.5 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.6 Record the value of signals specified in 6.2.11.5.1.

CG 3120 SCT TRUN 1X RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2, and R3 displays when the "MARK" pushbutton is pressed are as follows:
R1 is Shaft Angle as XXX.XX degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

NOTE: [illegible] is not within ± .10 repeat [illegible]

6.2.11.5.7 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.5.5 as Δ Trun, and Δ Time.

11.5.5

6.2.11.5.8 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.5.9 The Trunnion slew rate shall be 1.0 ± 0.2 degrees/seconds

6.2.11.5.10 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished, return selector to MANUAL position.

6.2.11.5.11 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.00 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.5.12 before proceeding. Do not hold control stick at right limit for more than ten seconds.

6.2.11.5.12 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.13 Record the value of the following signal on the CRT.

c) CG 3131 SCT SHAFT 1X RES ERROR shall be less than 0.20 VRMS

NOTE: The R1, R2 and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

5.12 6.2.11.5.14 Compute the respective differences between the R1, and R3 displays recorded in 6.2.11.5.12 as △ Shaft, and △ Time.

6.2.11.5.15 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\triangle \text{ Shaft}}{\triangle \text{ Time}}$$

6.2.11.5.16 The Shaft slew rate shall be 2.0 ± 0.4 degrees/second.

6.2.11.6 Slew Rate - Low Speed

6.2.11.6.1 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to LO.

6.2.11.6.2 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.6.3 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.6.4 before proceeding. Do not hold control stick at upper limit for more than thirty seconds.

6.2.11.6.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately recoru the displays in R1, R2, and R3, In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.5 Record the value of signal b) specified in 6.2.12.5.1 of the Medium Speed Test.

b) CG 3120 SCT TRUN 1X RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2 and R3 displays when the "MARK" pushbutton is pressed are as follows:
R1 is Shaft Angle as XXX.XX degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

6.2.11.6.6 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.6.4 as △ Trun, and △ Time.

6.2.11.6.7 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.6.8 The Trunnion slew rate shall be 0.1 ± 0.02 degrees/second.

6.2.11.6.9 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished return selector to MANUAL position.

6.2.11.6.10 Record the SHAFT CDU and 2X TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.6.11 before proceeding. Do not hold control stick at right limit for more than ten seconds.

6.2.11.6.11 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is displayed. Press KEY RLSE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.12 Record the value of the following signal on the CRT.

c) CG 3131 SCT SHAFT 1X RES ERROR shall be less than 0.20 VRMS

NOTE: The R1, R2 and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

6.2.11.6.13 Compute the respective differences between the R1 and R3 displays recorded in 6.2.11.6.11 as Δ Shaft, and Δ Time.

6.2.11.6.14 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.6.15 The Shaft slew rate shall be 0.2 ± 0.04 degrees/second.

6.2.11.7 AGC Optics Slewing

6.2.11.7.1 Set the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, set the selector to COMPUTER.

6.2.11.7.2 Set up the Analog Recorder 4A3-A2 to monitor the following signals:

a. CG 3106, SXT TRUNNION TACH FEEDBACK	4A3-A2-1-3
b. CG 3115, SXT SHAFT TACH FEEDBACK	4A3-A2-7-1
c. CG 3134, SCT TRUNNION TACH FEEDBACK	4A3-A2-4-3
d. CG 3124, SCT SHAFT TACH FEEDBACK	4A3-A2-3-2

6.2.11.7.3 Enter the following sequence into K148:

a. VERB 41, NOUN 55, ENTER

b. +27000, ENTER

c. +60000, ENTER

d. VERB 21, NOUN 01, ENTER

e. 00724, ENTER

f. 40000 (do not enter)

6.2.11.7.4 Start the Analog Recorder at 10 mm/sec and depress the ENTER button on the K148. Wait until the transients have died out and stop the Analog Recorder. Record the elapsed time for each signal in 6.2.11.7.2 to reach its final value. In all cases, the elapsed time for the signals in 6.2.11.7.2 shall be less than 50 sec.

6.2.11.7.5 Record the SHAFT and 2X TRUNNION CDU dial indications. The SHAFT CDU shall read 270.0 ± 0.022 degrees. The 2X TRUNNION CDU shall read 120.00 ± 0.01 degrees.

6.2.11.7.6 Place the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.11.7.7 Verify that G&N System is in the Coarse Align Mode under Computer control.

6.2.12 Optics Coordinate Transformation Control Test

6.2.12.1 Proceed with this test if 6.2.4, Operate Power On Test, or 6.2.2.2., Turn On Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2., Turn On Procedure, before proceeding with this test.

6.2.12.2 Insure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel are pushed in and that the G&N System is in the Coarse Align mode. The COARS ALIGN lamp on the IMU CONTROL Panel shall be the only MODE lamp illuminated.

6.2.12.3 Verify that the TRANSFER switch on the IMU CONTROL Panel is set to COMPUTER.

6.2.12.4 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.12.5 Set the CONTROLLER MODE switch on the G&N Indicator Control Panel to DIRECT.

6.2.12.6 Optics Coordinate Transformation Control Test.

6.2.12.6.1 Using the control stick at desired speed, set SHAFT ANGLE CDU to 225.000 degrees and 2X TRUNNION CDU to 10.000 degrees. Set CONTROLLER SPEED to LO to minimize drift.

6.2.12.6.2 Sight through the SCT eyepiece. Move the movable target so it is centered on the SCT reticle pattern. Maintain 2X TRUNNION CDU at 10.000±0.200 degrees and SHAFT ANGLE CDU at 225.000±0.200 degrees by manipulating control stick.

6.2.12.6.3 Set the switches on the G&N Indicator Control Panel as follows:

a. CONTROLLER MODE TO RESOLVED
b. CONTROLLER SPEED TO MED

NOTE: The following step will require coordination between the K START and Command Module operators. Each should read and thoroughly understand this step before proceeding.

NOTE: The requirement 30±6 seconds, applies only to the absence of the Passive Thermo Protection System on the exterior optics. With the presence of the Passive Thermo Protection System the difference of the R3 indications shall be 15 to 28 seconds.

6.2.12.6.4 Simultaneously sight through the SCT eyepiece, quickly displace the CONTROL STICK 45 degrees in the upper right hand quadrant and press the MARK push-button. Record the CRT indication of R3. Observe the viewed object and when it leaves the SCT upper rightfield of view press the MARK pushbutton. Record the CRT indications of R1 and R3. R1 indication shall be 225±10 degrees and the difference of the R3 indication shall be 30±6 seconds.

6.2.12.6.5 Set the CONTROLLER MODE switch on the G&N Indicator Control Panel to DIRECT.

6.2.12.6.6 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.12.7 Mark Pushbutton Test

6.2.12.7.1 Using the CONTROL STICK at desired controller speed, set the SHAFT CDU to 60.000 ± 0.010 degrees and 2X TRUNNION CDU to 30.000 ± 0.010 degrees.

6.2.12.7.2 Press the MARK pushbutton on G&N Indicator Control Panel.

6.2.12.7.3 Observe VERB 06 NOUN 56 displayed on CRT.

6.2.12.7.4 The OPTX counter in R1 shall indicate 06000 ± 00003. Record the counter from CRT.

6.2.12.7.5 The OPTX counter in R2 shall indicate 15000 ± 00014. Record the counter from CRT.

6.2.12.7.6 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.13 Optics Positional Accuracy Test

6.2.13.1 Proceed with this test if 6.2.4, Operate Power On Test, or 6.2.2.2, Turn On Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn On Procedure, before proceeding.

NOTE: This test requires the use of G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS in accordance with "Alignment of Optical Target GSE on Spacecraft Process Specification No. MA 0201-5036."

Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

Insure that qualified personnel are available outside the Spacecraft to take observations and position the retro-reflecting prism.

6.2.13.2 G&N System shall be in COARSE ALIGN MODE under AGC control. Optics operate power shall be applied by pushing in the OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker panel.

6.2.13.3 Optics controls on the G&N Indicator Control Panel shall be set as follows:

a) CONTROLLER SPEED - LOW
b) CONTROLLER MODE - DIRECT
c) SLAVE TELESCOPE - STAR LOS
d) OPTICS MODE - ZERO OPTICS

NOTE: When directed to use Control Stick to drive optics, set CONTROLLER SPEED selector to position desired and drive optics. Always return selector to LOW position to prevent excessive LOS drift.

6.2.13.4 Resolution Checks

6.2.13.4.1 After ZERO ENCODER lamp has extinguished, set OPTICS MODE switch to MANUAL position.

6.2.13.4.2 Sight on the 5-inch Autocollimator, through the SXT eyepiece. Using the CONTROL STICK to drive the SXT to the approximate position, adjust the TRUNNION and SHAFT ANGLE to view the autocollimator resolution pattern at the center of the field of view.

6.2.13.4.3 Note that the 5-inch autocollimator resolution pattern contains a series of lines of different thickness and width. Each set of lines is marked with a numeral (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space in seconds of arc. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines.

6.2.13.4.3.1 The SXT resolution shall be at least 10 arc seconds at center of field of view.

6.2.13.4.4 Sight through the SCT eyepiece and align the SCT with the control stick until the SCT resolution chart is centered in the field of view, using the SCT and the resolution chart. Record the number of the lowest numbered set distinctly seen with the SCT. The SCT shall demonstrate a resolution of at least 3 arc minutes at center of field of view.

6.2.13.5 Slave Telescope Mode Checks

6.2.13.5.1 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, return selector to MANUAL position. Verify SLAVE TELESCOPE switch is in the STAR LOS position.

6.2.13.5.2 Record SCT Shaft and Trunnion Angles on the TPAC and the SHAFT and 2X TRUNNION CDU indications. The difference between TPAC angles and corresponding CDU angles shall be less than 0.5 degrees.

NOTE: TPAC TRUNNION angle counter reading indicates LOS angles and 2X TRUNNION CDU angle reading indicates 2X LOS angle. The 2X TRUNNION CDU indication must be divided by two before subtracting from SCT TRUNNION display.

6.2.13.5.3 Using Control Stick, drive 2X TRUNNION and SHAFT CDU's to 35.500 degrees. Record TPAC shaft angle (35.5 ± 0.5 degrees) and Trunnion angle (17.75 ± 0.25 degrees) on the TPAC.

6.2.13.5.4 Repeat 6.2.13.5.1

6.2.13.5.5 Set SLAVE TELESCOPE Switch to LANDMARK LOS 0°.

6.2.13.5.6 Remove the plug from the base of SXT eyepiece. Install the Adapter Assembly and Portable Light Assembly in this location. Turn on the light.

NOTE: It will be necessary for the optics operator to communicate with the personnel outside the Spacecraft handling the optical GSE (Retroreflecting Prism, Autocollimator, etc.) through 6.2.13.8.2.

If needed to reduce external light, obtain, place, and secure a photographer's hood over the optics head and the retroreflecting prism.

6.2.13.5.7 Sight through the SCT eyepiece and give direction for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS, so that the illumination from the backlight filament is clearly visible at the center of the field. The prism must be held in this position until after completion of Step 6.2.13.5.12.

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6.2.13.5.8 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Adjust the 2X TRUNNION CDU with OPTICS CONTROL Stick to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the 2X TRUNNION CDU angle. The difference between this angle and the corresponding angle recorded in Step 6.2.13.5.2 shall be less than ± .440 degrees.

6.2.13.5.9 Replace the Portable Light in the adapter in the SXT eyepiece.

6.2.13.5.10 Readjust the 2X TRUNNION CDU to obtain the values ± .002 degrees recorded in Step 6.2.13.5.2 (at the zero optics position). Then set SLAVE TELESCOPE Switch to STAR LOS.

6.2.13.5.11 To temporarily disable the electrical drive to the SCT TRUNNION, carefully unscrew the SCT TRUNNION Manual Drive item until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

6.2.13.5.12 Verify that the Retroreflecting Prism is still in the desired position as in Step 6.2.13.5.7 by sighting into the SCT eyepiece. Then remove the Portable Light from the adapter and again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.13.5.8. Again observe the positions of the SCT and SXT reticles and adjust the 2X TRUNNION CDU with CONTROLLER Stick to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the 2X TRUNNION CDU angle. The difference between this angle and the corresponding angle recorded in Step 6.2.13.5.2 shall be less than ± .440 degrees. Replace the Portable Light in the adapter.

6.2.13.5.13 Replace the SCT TRUNNION Manual Adjust drive in the panel.

6.2.13.5.14 Use the Control Stick to drive the 2X TRUNNION CDU to 50.000 ± 0.005 degrees.

6.2.13.5.15 Set SLAVE TELESCOPE Switch to OFFSET 25°. After 30 seconds has elapsed from time of switch operation, record TPAC TRUNNION angle and CDU 2X TRUNNION angle. The difference shall be 25° ± 0.5 degrees. Also record CDU SHAFT angle.

6.2.13.5.16 To temporarily disable the electrical drive to the SCT TRUNNION and SCT SHAFT, carefully unscrew the SCT TRUNNION and SCT SHAFT Manual Drive item until they just release from the panel. Do not rotate further as this would displace the SCT LOS from the desired reference position.

6.2.13.5.17 For this step it is necessary to reposition the Retroreflecting Prism so that it is inclined at an angle 25° downward in such a position as to span the SCT LOS and the SXT StLOS. After the prism has been moved to the approximate position described above, again sight into the SCT eyepiece and give direction as necessary to adjust the prism position so that the illumination from the backlight filament is again visible at the center of the field. Then remove the Portable Light Assembly (from the SXT eyepiece adapter) and sight through the SXT eyepiece while directing the light assembly into the SCT eyepiece. Again observe the comparison of SCT and SXT reticles. Adjust the 2X TRUNNION CDU and the SHAFT CDU with OPTICS CONTROLLER Stick to bring the two reticle patterns into coincidence. Record the 2XTRUNNION CDU angle and the SHAFT CDU angle. The difference between each of these two angles and the corresponding values recorded in Step 6.2.13.5.15 shall be less than ± .440 degrees. Replace the SCT TRUNNION and SHAFT Manual Adjust drive in panel.

6.2.13.5.18 Replace Portable Light Assembly in the adapter. Set SLAVE TELESCOPE switch to STAR LOS. Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, return selector to MANUAL position. Verify SLAVE TELESCOPE Switch is in the STAR LOS position. Remove Hood (if used) and Retroreflecting Prism.

6.2.13.6 Sextant Parallelism Tests

6.2.13.6.1 Using Control Stick (with CONTROLLER SPEED switch HI), drive SXT StLOS to 30.000 ± 2.0 degrees as indicated on the 2X TRUNNION CDU.

6.2.13.6.2 Insure that SHAFT CDU readout indicates 000.000 ± 0.006 degrees. Use Control Stick to correct it, if required.

6.2.13.6.3 Sight through the autocollimator eyepiece and superimpose the sextant horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.

6.2.13.6.4 Repeat 6.2.13.6.3 twice and record the average of the three autocollimator readings.

6.2.13.6.5 Set OPTICS MODE selector to ZERO OPTICS. Return selector to MANUAL position after ZERO ENCODER lamp is extinguished on the Condition Annunciator Panel.. Insure that 2X TRUNNION CDU readout indicates 000.000 ± 0.006 degrees, and SHAFT ANGLE CDU indicates 000.000 ± .006 degrees. Correct if necessary. Record 2X TRUNNION and SHAFT CDU indications.

6.2.13.6.6 Again sight through 5 inch autocollimator eyepiece and adjust the horizontal filar (not autocollimator) to bring StLOS horizontal reticle line and filar horizontal image to coincidence. Record the average of three filar position indications. This reading shall not differ from that obtained in 6.2.13.6.4 by more than 15 arc seconds.

6.2.13.7 Shaft and Trunnion Positional Accuracy Checks

6.2.13.7.1 Set OPTICS MODE selector to ZERO OPTICS. Return selector to COMPUTER position after ZERO ENCODER lamp is extinguished.

6.2.13.7.2 Enter VERB 41, NOUN 55 into the K-148. Press ENTER pushbutton. The VERB-NOUN display shall indicate 21-57 flashing on CRT.

6.2.13.7.3 Enter 00400 into the K-148. Press ENTER pushbutton. Enter 00200 into the K-148. Press ENTER pushbutton. The VERB-NOUN display on CRT shall stop flashing.

6.2.13.7.4 Enter VERB 14, NOUN 55 into K-148. Press ENTER pushbutton. Record the value of the SHAFT and TRUNNION CDU counters in R1 and R2 on CRT.

6.2.13.7.5 Record SHAFT and 2X TRUNNION CDU indications.

6.2.13.7.6 Set OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp is extinguished, return selector to MANUAL.

6.2.13.7.7 Using Optics Hand Controller, set SHAFT and 2X TRUNNION CDU's to the values recorded in 6.2.13.7.5.

6.2.13.7.8 Record the value of the SHAFT and TRUNNION CDU counters in R1 and R2 on CRT.

6.2.13.7.8.1 The values of 6.2.13.7.8 shall differ from those of 6.2.13.7.4 by no more than ±00005.

NOTE: Read and understand 6.2.13.7.9 before proceeding.

6.2.13.7.9 Sight through the SXT. Using Control Stick, align the SXT StLOS with optical target No. 1. At the instant of coincidence, simultaneously press "MARK" pushbutton and read the SHAFT TRUNNION CDU indication.

NOTE: VERB 06, NOUN 56 shall appear on DSKY indicating optical CDU and time displays.

6.2.13.7.10 Record the SHAFT angle as indicated on R1 and TRUNNION angle as indicated on R2 of LEB DSKY. Record the SHAFT and 2X TRUNNION CDU indication.

6.2.13.7.10.1 Repeat 6.2.13.7.9 through 6.2.13.7.10 two more times. If two of the specific recorded angles are equal, record this angle. If all three of the recorded angles are different, select the value that is between the higher and lower values.

6.2.13.7.11 Sight through the SXT. Using Control Stick, align the SXT StLOS with Optical Target No. 2. At the instant of coincidence, simultaneously press "MARK" pushbutton and read SHAFT and TRUNNION CDU.

NOTE: VERB 06, NOUN 56 shall appear on DSKY.

6.2.13.7.12 Record the SHAFT angle as indicated on R1 and TRUNNION angle as indicated on R2 of LEB DSKY. Record the SHAFT and 2X TRUNNION CDU indication.

6.2.13.7.12.1 Repeat 6.2.13.7.11 through 6.2.13.7.12 two more times. If two of the specific recorded angles are equal, record this angle. If all three of the recorded angles are different, select the value that is between the higher and lower values.

6.2.13.7.13 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, set selector to COMPUTER position.

6.2.13.7.14 Enter VERB 41, NOUN 55 into K-148. Press ENTER pushbutton. VERB-NOUN display shall flash 21-57.

6.2.13.7.15 Enter the value recorded from R1 in 6.2.13.7.10.1 into K-148. Press ENTER pushbutton.

6.2.13.7.16 Enter the value recorded from R2 in 6.2.13.7.10.1 into K-148. Press ENTER pushbutton.

6.2.13.7.17 Sight through the SXT. The StLOS should be centered on Optical Target No. 1 on A23-071. Record SHAFT and 2X TRUNNION CDU indications.

6.2.13.7.18 Enter VERB 41, NOUN 55 into K-148. Press ENTER pushbutton. VERB-NOUN displays shall flash 21-57.

6.2.13.7.19 Enter the value recorded from R1 in 6.2.13.7.12.1 into the K-148. Press ENTER pushbutton.

6.2.13.7.20 Enter the value recorded from R2 in 6.2.13.7.12.1 into the K-148. Press ENTER pushbutton.

6.2.13.7.21 Sight through the SXT. The StLOS should be centered on Optical Target No. 2 on A23-071. Record SHAFT and 2X TRUNNION CDU indications.

6.2.13.7.22 The difference between the SHAFT CDU indications from 6.2.13.7.10.1 and 6.2.13.7.17 shall not exceed 0.025 degrees. Record this difference.

6.2.13.7.22.1 The difference the 2X TRUNNION CDU indications from 6.2.13.7.10.1 and 6.2.13.7.17 shall not exceed 0.025 degrees. Record this difference.

6.2.13.7.22.2 The difference between the SHAFT CDU indications from 6.2.13.7.12.1 and 6.2.13.7.21 shall not exceed 0.025 degrees. Record this difference.

6.2.13.7.22.3 The difference between the 2X TRUNNION CDU indications from 6.2.13.7.12.1 and 6.2.13.7.21 shall not exceed 0.025 degrees. Record this difference.

6.2.13.8 SXT StLOS-LLOS Parallelism Test, 90 Degree Position

6.2.13.8.1 Set the OPTICS MODE selector to ZERO OPTICS position. After the ZERO ENCODER lamp is extinguished, set selector to MANUAL position.

6.2.13.8.2 Set CONTROLLER SPEED to MEDIUM. [illegible]. Using Control Stick, drive the SXT TRUNNION axis until the 2X TRUNNION CDU indicates 175 ± 5 degrees.

6.2.13.8.3 Set CONTROLLER SPEED to LO and drive the 2X TRUNNION CDU until it indicates 180.000 degrees. Insure that the SHAFT CDU indicates 0.000 ± 0.006 degrees.

6.2.13.8.4 If necessary, cover the optics head with a photographer's hood (or any acceptable substitute) to block stray light from the sextant head.

6.2.13.8.5 Turn on SXT Portable Light Assembly

6.2.13.8.6 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Hand Controller to adjust the SXT TRUNNION axis until the two horizontal reticle lines are coincident. Record the 2X TRUNNION angle.

6.2.13.8.6.1 The 2X TRUNNION CDU shall indicate 180.000 ± 0.020 degrees.

6.2.13.8.7 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace Sextant eyepiece plug.

6.2.13.9 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished on the Condition Annunciator Panel, return selector to MANUAL position.

6.2.13.10 Verify that the SHAFT CDU and 2X TRUNNION CDU indications on the OPTICS CDU readout indicate 000.000 ± 0.006 degrees.

6.2.13.11 Remove OPTICS power by pulling out OPTICS MNA and MNB breakers or Right Hand Circuit Breaker panel.

6.2.14 AGC Mode Control Test

6.2.14.1 Proceed with this test if 6.2.4 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.14.2 Verify that the TRANSFER switch is set to COMPUTER and COARSE ALIGN is the only mode lamp lighted.

6.2.14.3 Verify that the MODE pushbutton on the IMU CONTROL panel will not effect a mode change by pressing each button not lighted. The COARS ALIGN MODE lamp shall remain lighted.

6.2.14.4 Zero Encode Mode

6.2.14.4.1 Enter VERB 25, NOUN 22 into K- 148. Press the ENTER pushbutton.

6.2.14.4.2 Enter +04000 into K- 148. Press the ENTER pushbutton.

6.2.14.4.3 Enter +04000 into K-148. Press the ENTER pushbutton.

6.2.14.4.4 Enter +04000 into K- 148. Press the ENTER pushbutton.

6.2.14.4.5 Wait 30 seconds.

NOTE: Perform 6.2.14.4.6 through 6.2.14.4.10 within 30 seconds.

6.2.14.4.6 Enter VERB 40, NOUN 20 into K- 148. Press the ENTER pushbutton.

6.2.14.4.7 Verify the K Relays on CRT indicate 001001 immediately after pushing ENTER pushbutton. Record.

6.2.14.4.8 Verify that the INNER, MIDDLE, and OUTER Gimbal CDU's indicate 000.000 ± 1.00 degrees. Record.

6.2.14.4.9 Enter VERB 15, NOUN 20 into K- 148. Press the ENTER pushbutton.

NOTE: (a) KEY RELEASE and CHECK FAIL will be lighted. Press KEY RELEASE on DSKY.

(b) CDU FAIL will momentarily light on Condition Annunciator Panel.

6.2.14.4.10 Verify that the contents of R1, R2, and R3 on CRT indicate all zeros. Record.

6.2.14.4.11 Verify ZERO ENCODER on Condition Annunciator Panel has extinguished before proceeding.

6.2.14.5 Coarse Align Mode

6.2.14.5.1 Enter VERB 41, NOUN 20 into K-148. Press the ENTER pushbutton.

6.2.14.5.2 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.3 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.4 Enter +00000 into K-148. Press the ENTER pushbutton. Wait 60 seconds.

NOTE: The PGNS lamp will light on the Condition Annunciator Panel. Disregard lamp indication.

6.2.14.5.5 Set up the Analog Recorder 4A3-A2 to monitor the following signals:

Signal

a. CG 2110 IGA TORQUE MOTOR INPUT

b. CG 2140 MGA TORQUE MOTOR INPUT

c. CG 2170 OGA TORQUE MOTOR INPUT

6.2.14.5.6 Enter (and verify) VERB 41, NOUN 20 (COARSE ALIGN) into K-148. Press ENTER pushbutton.

6.2.14.5.7 Enter +06000 into K-148 twice. Press ENTER pushbutton after each entry.

6.2.14.5.8 Start Analog Recorder 4A3-A2. Enter +06000 into K-148. Press ENTER pushbutton.

NOTE: The GIMBAL LOCK lamp on the Condition Annunciator and PROGRAM alarm lamp on LEB DSKY may light. Press ERROR RESET pushbutton and continue.

6.2.14.5.9 After the transients have died out, stop Analog Recorder 4A3-A2. Determine the time elapsed on each signal specified in 6.2.14.5.5 between the initial and final transients. Record elapsed times. The elapsed times for IGA, OGA, and MGA to drive from zero degrees to 60 degrees shall be no greater than 21 seconds.

6.2.14.5.10 Verify that the K Relays on CRT indicate 000010. Record.

6.2.14.5.11 Record IMU-CDU DIFFERENCE meter indications for the INNER, MIDDLE, and OUTER GIMBAL channels. The INNER, MIDDLE, and OUTER indicators in the IMU-CDU DIFFERENCE meter shall be 0 ± 1.0 degrees.

6.2.14.5.12 Record the indicated value of the following signals in Table VII on the CRT.

Table VII Signal Voltage Requirements

	Signals	Requirements
1.	CG 2206 IGA CDU IX RES ERROR	0.0 to .210 VRMS
2.	CG 2236 MGA CDU IX RES ERROR	0.0 to .210 VRMS
3.	CG 2266 OGA CDU IX RES ERROR	0.0 to .210 VRMS
4.	INNER GIMBAL ANGLE	60 ± 2.5 degrees
5.	MIDDLE GIMBAL ANGLE	60 ± 2.5 degrees
6.	OUTER GIMBAL ANGLE	60 ± 2.5 degrees
7.	CG 2209 SCS PITCH	0.0 ± 1.00 degrees
8.	CG 2239 SCS YAW BODY AXIS	0.0 ± 1.00 degrees
9.	CG 2241 SCS YAW OFFSET AXIS	0.0 ± 1.00 degrees
10.	CG 2269 SCS ROLL BODY AXIS	0.0 ± 1.00 degrees
11.	CG 2271 SCS ROLL OFFSET AXIS	LLL to UUU degrees

6.2.14.6 Fine Align Mode

NOTE: **The Program Alarm and GIMBAL LOCK indication may be present during the duration of the FINE ALIGN Mode test.**

6.2.14.6.1 Enter (and verify) VERB 42 into K-148. Press ENTER pushbutton to advance G&N to the FINE ALIGN mode. The VERB-NOUN display shall indicate 21-67 flashing.

6.2.14.6.2 Enter +00000 three times pressing ENTER pushbutton after each entry into K-148. Press ENTER pushbutton. Verify VERB-NOUN display shall stop flashing. The FINE ALIGN MODE lamp on the IMU CONTROL Panel is the only MODE lamp that is lighted.

6.2.14.6.3 Record the indicated values of the following signals in Table VIII on the CRT.

Table VIII Voltage Requirements

	Signals	Requirements
a.	CG 2204 IGA CDU 16X RES ERROR	0.0 to .125 VRMS
b.	CG 2234 MGA CDU 16X RES ERROR	0.0 to .125 VRMS
c.	CG 2264 OGA CDU 16X RES ERROR	0.0 to .125 VRMS
d.	CG 2107 OGA SERVO ERROR	0.0 to .23 VRMS
e.	CG 2137 MGA SERVO ERROR	0.0 to .23 VRMS
f.	CG 2167 OGA SERVO ERROR	0.0 to .23 VRMS

6.2.14.6.3 (continued)

Table III Voltage Requirements

	Signals	Requirements
g.	CG 2209 SCS PITCH ERROR	0 ± 1.00 degrees
h.	CG 2239 SCS YAW BODY AXIS	0 ± 1.00 degrees
i.	CG 2241 SCS YAW OFFSET AXIS	0 ± 1.00 degrees
j.	CG 2269 SCS ROLL BODY AXIS	0 ± 1.00 degrees
k.	CG 2271 SCS ROLL OFFSET AXIS	LLL to UUU degrees

6.2.14.6.4 Record the INNER, MIDDLE, and OUTER GIMBAL CDU indications. The INNER, MIDDLE, and OUTER indicator on the IMU-CDU DIFFERENCE meter shall be 0.0 ± 1.0 degrees.

6.2.14.6.5 Verify that the K-RELAYS on CRT indicate 001000.

6.2.14.6.6 Insert the following into LEB DSKY.

a. Insert VERB 41, NOUN 20 ENTER

b. Insert +00000, ENTER

c. Insert +00000, ENTER

d. Insert +00000, ENTER

e. Wait 60 seconds.

Observe that Gimbal Lock lamp extinguishes, if Prog Alarm is lighted, press Error Reset.

6.2.15 Gimbal Friction Test

6.2.15.1 Obtain the Gimbal Friction Test Tape No. F040017-K00031-XX and install on TAPE READER.

6.2.15.2 Set the POWER/ON Switch on the TAPE READER 4A4-A2 to ON. Perform the following steps on Console 4A4-A3 in sequence:

a. Press the TAPE/KEY indicator to TAPE.

b. Press the FWD/REV indicator to FWD.

c. Press the IND/CONT indicator to CONT.

d. Press the LOAD/INH indicator to LOAD.

6.2.15.3 Set up Analog Recorder 4A1-A3 to monitor the following signals:

a. CG 2110 IGA TM IN

b. CG 2140 MGA TM IN

c. CG 2170 OGA TM IN

6.2.15.4 Press RUN indicator on K-148. Wait 90 seconds after tape stops.

6.2.15.5 Press RUN indicator on K-148. Wait 60 seconds after tape stops.

6.2.15.6 Press RUN indicator on K-148. Wait for tape to stop.

6.2.15.7 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate IG Clockwise Friction Test. After about 9 minutes observe, CRT. When IG CDU angle indication stops changing, stop analog recorder. IG CDU angle should be 000 ± 010 degrees.

6.2.15.8 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.9 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate IG Counter clockwise Friction Test. After about 9 minutes observe CRT. When IG CDU angle stops changing, stop analog recorder. IG CDU angle should be 000 ± 010 degrees.

6.2.15.10 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.11 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate OG Clockwise Friction Test. After about 9 minutes, observe CRT. When OG CDU angle stops changing, stop analog recorder. OG CDU angle should be 000 ± 010 degrees.

6.2.15.12 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.13 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate OG Counter-clockwise Friction Test. After about 9 minutes, observe CRT. When OG CDU angle stops changing, stop analog recorder. OG CDU angle should be 000 ± 010 degrees.

6.2.15.14 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.15 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate MG Clockwise Friction Test. After about 3 minutes, observe CRT. When MG CDU angle stops changing, stop analog recorder. MG CDU angle should be +050 ± 010 degrees.

6.2.15.16 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.17 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate MG Counter-clockwise Friction Test. After about 3 minutes, observe CRT. When MG CDU angle stops changing, stop analog recorder. MG CDU angle should be +310 ±010 degrees.

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6.2.15.18 Press RUN indicator on K- 148. Wait for tape to stop and remove from TAPE READER.

6.2.15.19 Observe the six active traces on the analog recorder. Determine that none of the traces indicate greater than 7.5 VDC for a period not to exceed 5MM throughout the range of the active trace.

6.2.16 **Stabilization Loop Step Response Test**

6.2.16.1 Proceed with this test if 6.2.4, Operate Power On Test has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedures before proceeding.

6.2.16.2 Set the TRANSFER switch on the IMU CONTROL Panel to COMPUTER.

NOTE: The computer PROGRAM ALARM will be lighted. Disregard and press ERROR RESET button on LEB DSKY.

6.2.16.3 Enter VERB 36 into DSKY. Press the ENTER pushbutton, then the ERROR RESET pushbutton. Verify all AGC alarms are not lighted.

6.2.16.4 Inner Gimbal Response Test

6.2.16.4.1 Enter the code 2 010 000 000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2107 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.16.4.2 Insert the following sequence into DSKY:

a. VERB 41, NOUN 20, ENTER
b. +00500 ENTER
c. +00500 ENTER
d. +00500 ENTER

Wait 60 seconds

6.2.16.4.3 Insert VERB 41 NOUN 20 into DSKY. Press ENTER pushbutton. Enter +00000 into DSKY three times. Press ENTER after each entry. Wait 60 seconds.

CAUTION: If the transient caused by the transition to Fine Align does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA and MNB circuit breakers on the right hand circuit breaker panel.

6.2.16.4.4 Start Analog Recorder 4A1-A3 using a chart speed of 100 MM/SEC.

6.2.16.4.5 Enter VERB 42 into DSKY. Press ENTER pushbutton. Verify that the FINE ALIGN lamp is lighted on the IMU Control Panel.

6.2.16.4.6 Enter VERB 33 into DSKY. Press ENTER pushbutton.

6.2.16.4.7 After transient has died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.16.4.7.1 The Inner Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.4.7.2 The maximum number of overshoots on the torque motor input signals shall be two.

6.2.16.5 Middle Gimbal Response Test

6.2.16.5.1 Enter the code 2 021 000 000 into C-START MODULE 4A1-A5-0156. Press the XEQ/SEAL pushbutton to call up CG 2137 MGA SERVO ERROR on 4A1-A3-CH1.

6.2.16.5.2 Insert the following sequence into DSKY:

a. VERB 41, NOUN 20 ENTER
b. +00500 ENTER
c. +00500 ENTER
d. +00500 ENTER

Wait 60 seconds

6.2.16.5.3 Insert VERB 41 NOUN 20 into DSKY. Press ENTER pushbutton. Enter +00000 into DSKY three times. Press ENTER after each entry. Wait 60 seconds.

CAUTION: If the transient caused by the transition to FINE ALIGN does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA and MNB circuit breakers on the Right Hand Circuit Breaker panel.

6.2.16.5.4 Start Analog Recorder 4A1-A3 using a chart speed of 100 MM/SEC.

6.2.16.5.5 Enter VERB 42 into DSKY. Press ENTER pushbutton. Verify that the FINE ALIGN lamp is lighted on the IMU Control Panel.

6.2.16.5.6 Enter VERB 33 into DSKY. Press ENTER pushbutton.

6.2.16.5.7 After transients have died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.16.5.7.1 The Middle Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.5.7.2 The maximum number of overshoots on the torque motor input signals shall be two.

6.2.16.6 Outer Gimbal Response Test

6.2.16.6.1 Enter the code 2 025 000 000 C-START Module 4A1-A5-C156. Press XEQ/SEAL pushbutton to call up CG 2167 OGA SERVO ERROR On 4A1-A3-CH1.

6.2.16.6.2 Insert the following sequence into DSKY.

a. VERB 41, NOUN 20, ENTER
b. +00500 ENTER
c. +00500 ENTER
d. +00500 ENTER

Wait 60 seconds

6.2.16.6.3 Insert VERB 41 NOUN 20 into DSKY. Press ENTER pushbutton. Enter +00000 into DSKY three times. Press ENTER after each entry. Wait 60 seconds.

CAUTION: If the transient caused by the transition to FINE ALIGN does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA and MNB circuit breaker panel.

6.2.16.6.4 Start Analog Recorder 4A1-A3 using a chart speed of 100 MM/SEC.

6.2.16.6.5 Enter VERB 42 into DSKY. Press ENTER pushbutton. Verify that the FINE ALIGN lamp is lighted on the IMU Control Panel.

6.2.16.6.6 Enter VERB 33 into DSKY. Press ENTER pushbutton.

6.2.16.6.7 After transients have died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.16.6.7.1 The Outer Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.6.7.2 The maximum number of overshoots on the OGA SERVO ERROR signals shall be two.

6.2.16.7 Insert the following sequence into K148

a. VERB 40 NOUN 20 ENTER
Wait until ZERO ENCODER lamp goes out before proceeding.

b. VERB 41 NOUN 20 ENTER

c. +00000 ENTER

d. +00000 ENTER

e. +00000 ENTER

f. Verify that COARS ALIGN lamp is lighted on IMU Control Panel.

6.2.17 IRIG Scale Factor Test

6.2.17.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 before proceeding.

CAUTION: Verify that the IMU Operate power has been applied for a minimum of 1 hour and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.15.

6.2.17.2 Set up Analog Recorders 4A3-A2 and 4A1-A2 to monitor the following signals:

	Analog Recorder
a. CG 2110 IG TM INPUT	4A3-A2
b. CG 2140 MG TM INPUT	4A3-A2
c. CG 2170 OG TM INPUT	4A3-A2
d. CG 2117 IG SERVO ERROR	4A1-A2
e. CG 2147 MG SERVO ERROR	4A1-A2
f. CG 2177 OG SERVO ERROR	4A1-A2

6.2.17.3 Start Analog Recorder chart drive using a speed of 1 MM/Second. Recorder shall run for duration of this test.

6.2.17.4 Insert and verify the following sequence into K148.

VERB 57 ENTER

00005 ENTER

Observe 07 in MAJOR MODE

6.2.17.5 VERB 21 NOUN 30 shall flash on CRT requesting a load of the test numbers. Select the desired Test Number from Table XVIII. Enter the appropriate ±0000X into K148. Press the ENTER pushbutton.

Table XVIII. Test Numbers and Positions for IRIG Tests

Test Number	Gyro being tested and direction of torque
+00001	+X
-00001	-X
+00002	+Y
-00002	-Y
+00003	+Z
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in the above table. If only one gyro is being tested, the test need only be repeated for the two applicable Test Numbers.

6.2.17.6 During the following operation, disregard the CDU FAIL lamp indication unless specified:

The G&N System will automatically cycle through ZERO ENCODE, FINE ALIGN, ATT CONT, FINE ALIGN, COARS ALIGN, AND FINE ALIGN Modes. When alignment is completed for the specific IRIG under test, it will be torqued through approximately 360 degrees. There are six cycles of approximately 20 minutes each, which correspond to both plus and minus configurations of the X, Y, and Z IRIG's. The approach time period for one cycle test completion can be observed by performing the following sequences:

a. Insert Verb 11, NOUN 01 into K148. Press ENTER pushbutton.

b. Insert 01571 into K148. Press ENTER pushbutton.

c. Verify on CRT that R1 is counting down octally. When R1 has counted to zero, VERB 07 and NOUN 30 will be flashing. This indicates completion of one of the six cycles.

6.2.17.7 Record the value displayed in register R1 CRT for the appropriate Test Number in Table XIX.

Table XIX. Display of Test Parameters

Test Number	Symbol	Display in R1
+00001	ΔE_{-X}	± X X X X X
-00001	ΔE_{+X}	± X X X X X
+00002	ΔE_{-Y}	± X X X X X
-00002	ΔE_{+Y}	± X X X X X
+00003	ΔE_{-Z}	± X X X X X
-00003	ΔE_{+Z}	± X X X X X

6.2.17.8 Enter VERB 36 into K148. Press the ENTER pushbutton. Press The ERROR RESET switch on the LEB AGC DSKY.

6.2.17.9 Repeat 6.2.17.4 through 6.2.17.8 until all Test number in Table XVIII have been utilized.

6.2.17.10 After all completion of all test numbers, stop the Analog Recorder.

6.2.17.10.1 Enter VERB 40, NOUN 20 into K148. Press ENTER pushbutton. Wait 90 seconds.

6.2.17.10.2 Enter VERB 41, MOUN 20 into K148. Press ENTER pushbutton.

6.2.17.10.3 Enter +00000 into K148, three times, press ENTER pushbutton after each entry.

6.2.17.11 Perform the following calculations:

a. X IRIG Scale Factor Error

$$X_E = \frac{\Delta E_{+X} + \Delta E_{-X}}{2}$$

________ parts/million

b. Y IRIG Scale Factor Error

$$Y_E = \frac{\Delta E_{+Y} + \Delta E_{-Y}}{2}$$

________ parts/Million

c. Z IRIG Scale Factor Error

$$Z_E = \frac{\Delta E_{+Z} + \Delta E_{-Z}}{2}$$ _______parts/million

6.2.17.11.1 The Scale Factor error deviation for each IRIG shall be less than ± 1750 parts/million.

6.2.18 PIPA Scale Factor Determination Test

6.2.18.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn on Procedure before proceeding with this test.

6.2.18.2 Verify the IMU OPERATE power has been applied and that the IMU TEMP MODE switch has been in the AUTO OVERRIDE or PROPORTIONAL for a minimum of one hour.

6.2.18.3 Verify that the TRANSFER switch is set to COMPUTER position.

6.2.18.4 Test Initiation

6.2.18.4.1 Insert and verify the following sequence into K-148

a. VERB 57 ENTER

b. 00002 ENTER

Observe 07 in MAJOR MODE.

6.2.18.4.2 Observe VERB 06, NOUN 61 flashing. Rows R1 and R2 contain the NB azimuth and latitude respectively in degrees. If R1 and R2 agree with known azimuth and latitude insert VERB 33, ENTER into K148 and proceed to 6.2.18.4.4.

6.2.18.4.3 Insert and verify the following sequence into K148.

a. VERB 21 ENTER

b. +X X X.X X (Correct NB azimuth) ENTER

c. VERB 22 ENTER

d. +28523 (Correct NB latitude) ENTER

e. VERB 33 ENTER

6.2.18.4.4 Observe VERB 06 NOUN 66 flashing. Rows R1, R2, and R3 shall indicate:

R1 + 00032 (NB Tilt angle)
R2 - 00000 (Test Index)
R3 + 0000X (Test Position)

Where X indicates positions 1 through 6.

NOTE: To complete this test, positions 1 through 6 shall be performed.

If R1, R2 and R3 agree with the above, insert VERB 33, ENTER into K148 and proceed to 6.2.18.4.6.

6.2.18.4.5 Insert and verify the following sequence into K148.

a.	VERB 21, NOUN 02	ENTER
b.	01231	ENTER
c.	+00032 (Correct NB tilt)	ENTER
d.	VERB 21, NOUN 01	ENTER
e.	01232	ENTER
f.	-00000 (Correct Index)	ENTER
g.	VERB 21 NOUN 02	ENTER
h.	01223	ENTER
i.	+0000X (position)	ENTER
j.	VERB 33	ENTER

6.2.18.4.6 After approximately 5 minutes record CRT indications of OG, IG and MG CDU angles.

6.2.18.4.7 After approximately 18 minutes, VERB 06 NOUN 66 will appear flashing Record R1 (XXXXX), R2 (.XXXXX) and R3 (position number).

Table XXI

Position No. as Displayed in R3	PIPA Being Tested and its Orientation
00001	X PIPA Up
00002	X PIPA Down
00003	Z PIPA Up
00004	Z PIPA Down
00005	Y PIPA Up
00006	Y PIPA Down

6.2.18.4.8 If it is desired to perform the test in the next position, enter VERB 33 into K148. Press the ENTER pushbutton and return to 6.2.18.4. After completion of position 6, the test shall be terminated by entering VERB 34 into K148. Press the ENTER pushbutton.

6.2.18.4.9 Enter VERB 40, NOUN 20 into K148. Press the ENTER pushbutton. Wait until ZERO ENCODER lamp extinguishes before proceeding.

6.2.18.4.10 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.18.4.11 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.18.4.12 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.18.4.13 Enter +00000 into K148. Press the ENTER pushbutton. The COARS ALIGN mode lamp shall light.

6.2.18.5 Calculations

6.2.18.5.1 The values obtained from R1 and R2 for each position are combined as follows:

Contents of $(R1)_1$ Contents of $(R2)_1$

A_1 = ± X X X X X X X X X X

Where 1 = Position Number

A_1 = _____ . _____

A_2 = _____ . _____

A_3 = _____ . _____

A_4 = _____ . _____

A_5 = _____ . _____

A_6 = _____ . _____

6.2.18.5.2 Compute the average G for each PIPA using A_1 from step 1:

a. for X - PIPA $G_x = \frac{A_1 - A_2}{2} =$

b. for Z - PIPA $G_z \quad \frac{A_3 - A_4}{2} =$

c. for Y -PIPA $G_y \quad \frac{A_5 - A_6}{2} =$

6.2.18.5.3 Compute the PIPA scale factors using five significant figures from 6.2.18.5.2 and the value of local gravity obtained from Table XXII.

$$h_x = \frac{5.85 \text{ (local g)}}{G_x} = \underline{\qquad\qquad}$$

$$h_z = \frac{5.85 \text{ (local g)}}{G_z} = \underline{\qquad\qquad}$$

$$h_y = \frac{5.85 \text{ (local g)}}{G_y} = \underline{\qquad\qquad}$$

6.2.18.5.3.1 These values shall fall within 500 PPM of the nominal SF of 5.85 cm/sec/pulse.

6.2.18.5.3.2 Solve the following equations for D1, D2, and D2 for each PIPA scale factor.

$$D_1 = \left| X_{i-1} - X_i \right|$$

$$D_2 = \left| D_1 \right| + \left| X_{i-2} - X_{i-1} \right|$$

$$D_3 = \left| D_2 \right| + \left| X_{i-3} - X_{i-2} \right|$$

where:

X_i is the present measured value of the Scale Factor,

X_{i-1} is the measured value of the Scale Factor from the last Scale Factor Test,

X_{i-2} is the measured value of the Scale Factor from the test preceding X_{i-1}.

NOTE: X_{i-1} and X_{i-2} may be found in the G&N System Data Package.

The values of D1, D2, and D3 shall not exceed the following values: (See 5.1.2.5.1.1)

D1	400 PPM
D2	600 PPM
D3	750 PPM

6.2.18.5.4 Compute the PIPA biases using the values computed in 6.2.18.5.1 and 6.2.18.5.2 as follows:

$$b_x = \frac{(A_1 + A_2}{2} = \underline{\hspace{3cm}}$$

$$b_z = \frac{(A_3 + A_4)}{2} = \underline{\hspace{3cm}}$$

$$b_y = \frac{(A_5 + A_6)}{2} = \underline{\hspace{3cm}}$$

6.2.18.5.4.1 These values shall fall within 0.0±2.28 cm/sec^2.

TABLE XXII. LOCAL GRAVITY REQUIREMENTS

Location	Local Gravity (cm/sec^2)
KSC	979.24

6.2.18.5.4.2 Solve the following equations for D1, D2, and D3 for each PIPA Bias.

$$D_1 = \left|X_{i-1} - X_i\right|$$

$$D_2 = \left|D_1\right| + \left|X_{i-2} - X_{i-1}\right|$$

$$D_3 = \left|D_2\right| + \left|X_{i-3} - X_{i-2}\right|$$

Where:

X_i is the present measured value of the PIPA Bias,

X_{i-1} is the measured value of the PIPA Bias from the last PIPA Bias test,

X_{i-2} is the measured value of the PIPA Bias from the test preceding X_{i-1}.

NOTE: X_{i-1} and X_{i-2} may be found in the G&N System Data Package.

The values of D1, D2, and D3 shall not exceed the following values: (See 5.1.2.5.1.1)

D_1	0.5 cm/sec^2
D_2	0.7 cm/sec^2
D_3	0.9 cm/sec^2

6.2.19 IRIG Coefficient Determination Test

6.2.19.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been performed, and system operation has not been interrupted. If system operation has been interrupted, perform Turn On Procedure of 6.2.2.2 before Proceeding with this test.

CAUTION: Verify that the IMU Operate power has been applied for a minimum of 1 hour and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.15.

6.2.19.2 Verify or set transfer switch to COMPUTER.

6.2.19.3 Obtain, verify and record the azimuth orientation of Spacecraft Z Axis.

6.2.19.4 Insert and verify the following sequence into K148.

a. VERB 57 ENTER

b. Observe VERB 21, NOUN 01 Flashing

c. 00001 ENTER

d. Observe 07 in MAJOR MODE

6.2.19.5 Observe VERB 06, NOUN 61 flashing. Rows R1 and R2 shall contain the nav base azimuth and test site latitude respectively. If the azimuth and latitude indications are in agreement with the known values for these parameters press VERB 33, ENTER on K148 and proceed to 6.2.19.7.

6.2.19.6 Insert and verify the following sequence into K148.

a. VERB 21 ENTER

b. +X X X . X X (correct NB azimuth) ENTER

c. VERB 22 ENTER

d. +X X. XXX (correct site latitude) ENTER

e. VERB 33 ENTER

6.2.19.7 Observe VERB 06, NOUN 66 flashing with Rows R1, R2, and R3 indicating:

R1 +00032

R2 +00000

R3 +00001

If the above indications are present on the CRT or DSKY insert VERB 33, ENTER into K148 and proceed to 6.2.19.9.

6.2.19.8 Insert and verify the following sequence into K148.

a. VERB 21 NOUN 02 ENTER
b. 01231 ENTER
c. +00032 ENTER
d. VERB 21 NOUN 02 ENTER
e. 01232 ENTER
f. +00000 ENTER
g. VERB 21 NOUN 02 ENTER
h. 01223 ENTER
i. +00001 ENTER
j. VERB 33 ENTER

6.2.19.9 The G&N System will now cycle through the following modes as indicated on the IMU CONTROL Panel.

a. ZERO ENCODER
b. FINE ALIGN
c. ATT CONT
d. FINE ALIGN
e. COARS ALIGN
f. FINE ALIGN

6.2.19.10 Approximately 90 seconds after the final Fine Align mode is entered record indication of IG, MG and OG CDU's and the time.

6.2.19.11 After approximately 14 minutes, VERB 06, NOUN 66 will appear flashing. Record indication of the IG, MG and OG CDU's and the time. Record indication of R1 and R2.

NOTE: R1 should be ±00000.

6.2.19.12 Repeat test for positions 2 through 9 by inserting VERB 33 ENTER into K148 after performing step 6.2.19.11 and then performing 6.2.19.8j through 6.2.19.11. Proceed to step 6.2.19.13 after performing position 9.

6.2.19.13 Insert and verify the following sequence into K148:

a.	VERB 33		ENTER
b.	Observe VERB 06	NOUN 66	FLASHING
c.	VERB 21	NOUN 02	ENTER
d.	01231		ENTER
e.	+00032		ENTER
f.	VERB 21	NOUN 02	ENTER
g.	01232		ENTER
h.	+00001		ENTER
j.	VERB 21	NOUN 02	ENTER
k.	01223		ENTER
l.	-00001		ENTER
m.	VERB 33		ENTER

NOTE: Approximately 90 seconds after the final entry into the FINE ALIGN mode (f below) perform 6.2.19.15.

6.2.19.14 The G&N System will now cycle through the following mode as indicated on the IMU CONTROL panel.

a. ZERO ENCODER
b. FINE ALIGN
c. ATT CONT
d. FINE ALIGN
e. COARS ALIGN
f. FINE ALIGN

6.2.19.15 Insert and verify the following sequence into K148:

a.	VERB 06	NOUN 20	ENTER

6.2.19.16 Record the indications of LEB DSKY rows R1, R2 and R3 and the time.

6.2.19.17 After approximately 14 minutes, VERB 06, NOUN 66 will appear flashing. Record indication of OG, IG and MG CDU's and the time. Record the indications of R1 and R2.

6.2.19.18 Repeat the test for positions 2 through 6 by inserting VERB 33 ENTER into K148 after 6.2.19.17 and then performing 6.2.19.13m through 6.2.19.17.

6.2.19.19 After performing position 6 terminate test by inserting VERB 34 ENTER into K148.

6.2.19.20 Insert and verify the following sequence into K148:

a. VERB 41, NOUN 20, ENTER
b. +00000 ENTER
c. +00000 ENTER
d. +00000 ENTER

6.2.19.21 The data recorded for positions 1 through 9 when performing 6.2.19.11 has the following meaning:

Position	Displayed Drift Coefficients
1	+NBDY
2	+NBDZ
3	+NBDX
4	+NBDY + ADSRAY
5	+NBDZ + ADSRAZ
6	+NBDX + ADSRAX
7	+.707NBDY + 1/2ADSRA + .707NBDZ + 1/2ADSRAZ - 1/2ADIAZ
8	+.707NBDY + 1/2ADIAY - .707NBDX + 1/2ADSRAX - 1/2ADIAX
9	-.707NBDZ - 1/2ADIAZ + .707NBDX + 1/2ADIAX

6.2.19.22 The data recorded for positions 1 through 6 when performing 6.2.19.16 and 6.2.19.17 shall be utilized on the calculations sheets to derive the ADIA terms.

6.2.19.23 The following terms shall be solved on the calculation sheet and have the following tolerances:

NBD = 0±35 meru
ADSRA = 0±40 meru
ADIA = 0±100 meru

6.2.19.24 Solve the following equations for D1, D2, and D3 for each coefficient:

$$D_1 = \left|X_{i-1} - X_i\right|$$

$$D_2 = \left|D_1\right| + \left|X_{i-2} - X_{i-1}\right|$$

$$D_3 = \left|D_2\right| + \left|X_{i-3} - X_{i-2}\right|$$

Where:

X_i is the present measured value of the coefficient,

X_{i-1} is the measured value of the coefficient from the last coefficient determination,

X_{i-2} is the measured value of the coefficient from the test preceding X_{i-1}.

NOTE: X_{i-1} and X_{i-2} may be found in the G&N System Data Package.

The values of D1, D2 and D3 shall not exceed the following values: (See 5.1.2.5.1.1)

	NBD (meru)	ADIA (meru)	ADSRA (meru)
D1	8	17	14
D2	12	33	21
D3	14	40	25

6.2.20 Fine Alignment Test

6.2.20.1 Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.20.2 Prior to performing this test, the G&N Installation Qualification Fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Ref. No. 1) shall be known to ±30 minutes of arc.

CAUTION: Verify that the IMU Operate power has been applied for a minimum of 1 hour and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.15.

NOTE: System shall be in COARSE ALIGN mode under computer control with gimbal angles at zero. Insure that G&N OPTICS MNA and MNB breakers are on (pushed in).

6.2.20.3 Set OPTICS mode switch to ZERO OPTICS. After ZERO ENCODER lamp has extinguished on Condition Annunciator panel, return OPTICS mode switch to MANUAL.

6.2.20.4 Initiate the test by inserting the following into K148:

a. VERB 57 ENTER
b. Observe VERB 21, NOUN 01 flashing
c. 00003 ENTER
d. Observe PROGRAM lights, 07

6.2.20.5 Observe that the ZERO ENCODER lamps on Condition Annunciator and IMU CONTROL panel light and then extinguish.

6.2.20.6 Observe VERB 06, NOUN 61 flashing with the following display:

a. R1 + xxx.xx (Target 1 azimuth)
b. R2 ± xx.xxx (TGT 1 EL. degrees)
c. R3 00001 (TGT number)

If R1 and R2 are correct for present location insert VERB 33, ENTER into K148 and proceed to 6.2.20.9.

6.2.20.7 To correct R1, insert and verify the following into K148:

a. VERB 21 ENTER
b. + xxx.xx (Target 1 azimuth) ENTER

6.2.20.8 To correct R2, insert and verify the following into K148:

a. VERB 22 ENTER
b. ±xx.xxx ENTER
c. VERB 33 ENTER

6.2.20.9 Observe VERB 06, NOUN 61 flashing with the following display:

a. R1 + xxx.xx (Target 2 azimuth)
b. R2 ± xx.xxx (TGT 2 EL, degrees)
c. R3 00002 (TGT number)

If R1 and R2 are correct for present location insert VERB 33, ENTER into K148 and proceed to 6.2.20.12.

6.2.20.10 To correct R1, insert and verify the following into K148:

a. VERB 21 ENTER
b. + xxx.xx (Target 2 azimuth) ENTER

6.2.20.11 To correct R2, insert and verify the following into K148:

a. VERB 22 ENTER
b. ±xx.xxx ENTER
c. VERB 33 ENTER

6.2.20.12 Observe VERB 06, NOUN 61 flashing with the following display.

a. R1 + 13500 (SM AZ)
b. R2 + 28516 (LAT)

If R1 and R2 are correct for present location, insert VERB 33, ENTER into K148 and proceed to 6.2.20.15.

6.2.20.13 To correct R1 insert and verify the following into K148:

a. VERB 21 ENTER
b. + 13500 (correct SM AZ) ENTER

6.2.20.14 To correct R2 insert and verify the following into K148:

a.	VERB 22	ENTER
b.	+ 28516 (correct LAT)	ENTER
c.	VERB 33	ENTER

6.2.20.15 Observe VERB 21, NOUN 30 flashing, insert and verify 00001, ENTER into K148.

6.2.20.16 Observe VERB 51 flashing with R1 indicating 00001. Sight through SXT and align with TGT 1. Upon reticle coincidence, press MARK pushbutton. If satisfied with alignment, press ENTER pushbutton on DSKY. (If not satisfied with alignment, insert and verify VERB 52, ENTER into DSKY and repeat above procedure.)

6.2.20.17 Observe VERB 51 flashing with R1 indicating 00002. Sight through SXT and align with TGT 2. Upon reticle coincidence, press MARK pushbutton. If satisfied with alignment, press ENTER pushbutton on DSKY. (If not satisfied with alignment, insert and verify VERB 52, ENTER into DSKY and repeat above procedure.)

6.2.20.18 During approximately the next 3.5 minutes the following IMU moding will occur as indicated on the IMU CONTROL panel.

a. ZERO ENCODE
b. FINE ALIGN
c. ATTITUDE CONTROL
d. FINE ALIGN
e. COARSE ALIGN
f. FINE ALIGN

6.2.20.19 Repeat 6.2.20.16 and 6.2.20.17.

6.2.20.20 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Y PIPA IA about the Z_{SM}. Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Z PIPA IA about the Y_{SM}. Record R1 and R2.

6.2.20.21 Insert and verify VERB 34, ENTER into K148.

6.2.20.22 Repeat 6.2.20.4 through 6.2.20.14.

6.2.20.23 Observe VERB 21, NOUN 30 flashing, insert and verify 00002, ENTER into K148.

6.2.20.24 Repeat 6.2.20.16 through 6.2.20.19.

6.2.20.25 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the X PIPA IA about the Z_{SM}. Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Y PIPA IA about X_{SM}. Record R1 and R2.

6.2.20.26 Insert and verify VERB 34, ENTER into K148.

6.2.20.27 Repeat 6.2.20.4 through 6.2.20.14.

6.2.20.28 Observe VERB 21, NOUN 30 flashing, insert and verify 00003, ENTER into K148.

6.2.20.29 Repeat 6.2.20.16 through 6.2.20.19.

6.2.20.30 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the X PIPA IA about Z_{SM}. Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Z PIPA IA about the X_{SM}. Record R1 and R2.

6.2.20.31 Insert and verify the following into K148:

a.	VERB 34		ENTER
b.	VERB 41	NOUN 20	ENTER
c.	+ 00000		ENTER
d.	+ 00000		ENTER
e.	+ 00000		ENTER

6.2.20.32 The misalignment angle of an IA about any SM axis shall be 150 arc seconds or less.

6.2.20.33 Remove OPTICS power by pulling out OPTICS MNA and MNB breakers on Right Hand Circuit Breaker panel.

6.2.21 Gyrocompassing Test

6.2.21.1 Proceed with this test if the Operate Power On Test 6.2.4 or the Turn On Procedure of 6.2.2.2 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.2.2 before proceeding.

CAUTION: Verify that the IMU Operate power has been applied for a minimum of 1 hour and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.15.

6.2.21.2 Load the Flt Rope Cont Sim Flt Tape (F04C017-K00040-XX) on the tape reader. This tape loads nominal IRIG and PIPA parameters for G&N 122 and also loads gyrocompassing azimuth, latitude and Nav. Base azimuth for testing in the VAB. After display and verification of the data load, the tape will initiate the Prelaunch Alignment Program.

6.2.21.3 Apply G&N OPTICS power by pushing in OPTICS MNA and MNB breakers on Right Hand Circuit Breaker panel.

6.2.21.4 Start tape reader, after the tape reader stops, the data load may be changed by performing the following sequences.

6.2.21.4.1 If required to change the IRIG or PIPA data load:

a. Convert the data from engineering units to the AGC octal as stored in erasable memory.

b. Load the octal data into the AGC by inserting the following sequence into K148.

```
VERB     21      NOUN      02      ENTR
YYYYY    ENTR    (E-Memory address from Table XXIII)
XXXXX    ENTR    (OCTAL data)
```

6.2.21.4.2 If required to change the gyrocompassing azimuth data load:

a. Perform the following calculation:

$$\frac{\text{Gyrocompassing Azimuth}}{360} \times 16384 = \text{AAAA.BBBBB}$$

b. Load correction into AGC by inserting the following sequence into K148:

```
VERB       NOUN 02         ENTR
01316      ENTR
SOAAAA     ENTR            (S = sign)
VERB 21    NOUN 01         ENTR
01317      ENTR
SBBBBB     ENTR
```

IMU Compensation Term	E-Memory Location
NBDX	0744
NBDY	0745
NBDZ	0746
ADIAX	0747
ADIAY	0750
ADIAZ	0751
ADSRAX	0752
ADSRAY	0753
ADSRAZ	0754
PIPAX BIAS	0736
PIPAX S. F.	0737
PIPA Y BIAS	0740
PIPA Y S. F	0741
PIPA Z BIAS	0742
PIPA Z S. F	0743

Table XXIII IMU Compensation Terms

6.2.21.4.3 If required to change the nav. base azimuth data load:

a. Perform the following calculation:

$$\frac{\text{Nav. Base Azimuth}}{360} \text{ X } 16384 = \text{EEEE.FFFFF}$$

b. Load correction into AGC by inserting the following sequence into K148:

```
VERB 21        NOUN 02        ENTR
01352          ENTR
SOEEEE         ENTR           (S = sign)
VERB 21        NOUN 01        (ENTR)
01353          ENTR
SFFFFF         ENTR
```

6.2.21.4.4 If required to change the latitude data load:

a. Perform the following claculation:

$$\frac{\text{latitude}}{360} \text{ X } 16384 = \text{MMMM.NNNNN}$$

b. Load correction into AGC by inserting the following sequence into K148:

```
VERB 21        NOUN 02        ENTR
01314          ENTR
SOMMMM         ENTR
VERB 21        NOUN 01        ENTR
01315          ENTR
SNNNNN         ENTR
```

6.2.21.5 Start the tape reader.

6.2.21.5.1 When the tape reader stops, observe VERB 06, NOUN 61 flashing with R1 displaying gyrocompassing azimuth +71.99 degrees within ± 0.01 degrees.

6.2.21.6 Start the tape reader.

6.2.21.6.1 When the tape reader stops, observe VERB 06, NOUN 61 flashing with R1 displaying Nav. Base azimuth, +345.97 within 0.01 degrees and R2 displaying local latitude, +28.516 within 0.006 degrees.

6.2.21.7 Start the tape reader to initiate the Initialization and Inertial Reference portions of the Prelaunch alignment Program. Major Mode will indicate 01.

6.2.21.8 Within 10 minutes the MAJOR MODE lights will indicate 02 on the CRT and DSKY when the program enters the gyrocompass portion of the PRE-LAUNCH ALIGNMENT program. At this time, and during each succeeding 15 minute interval for the duration of the test, record in Table 6.1 the dial readings for the Outer Gimbal, Inner Gimbal and Middle Gimbal CDU's. After recording the first (t=0) set of data immediately proceed to step 6.2.21.9.

6.2.21.9 Set the CONTROLLER MODE switch to DIRECT, OPTICS MODE switch to ZERO OPTICS, and CONTROLLER SPEED switch to MED on the G&N Indicator Control Panel.

6.2.21.10 After the ZERO ENCODER lamp on Event Module 4A3-A4-E1-7 extinguishes set the Optics Mode switch to MANUAL.

6.2.21.11 Enter the following inputs into K148:

VERB 37, ENTR
03, ENTR

NOTE: The 03 will appear in the NOUN lights when entered. Following the pressing of the ENTR pushbutton, the NOUN lights will be blanked. When the test is entered, 03 will appear in the MAJOR MODE lights within 10 seconds and the KEY RELEASE lamp on the DSKY will illuminate.

6.2.21.12 Observe that the Major Mode lights indicate 03 on the CRT.

6.2.21.13 Press the KEY RELEASE Pushbutton on the LEB DSKY.

6.2.21.14 Perform paragraphs 6.2.20.6 through 6.2.20.11 of the G&N FINE ALIGNMENT TEST, to enter the correct components for TARGETS 1 and 2.

6.2.21.15 Observe that the "MARK" command, VERB 51 is flashing on the CRT and DSKY and that the following values are displayed in R1, R2 and R3.

R1	+ 00001	(Target #1)
R2	+ 00002	(Target #2)
R3	+ 00000	

6.2.21.16 Align the SXT StLOS with the reticle dot on Target #1. When aligned, press the MARK pushbutton.

6.2.21.16.1 If not satisfied with the MARK, enter VERB 52 into K148 or LEB DSKY. Press ENTR pushbutton and repeat step 6.2.21.16. If satisfied with the "MARK" proceed to 6.2.21.17. Observe that VERB 51 continues to flash on CRT and DSKY.

6.2.21.17 Align the SXT StLOS with the reticle dot on Target #2. When aligned, press the MARK pushbutton. Observe 50 in the VERB lights on the CRT and DSKY requesting operator action.

6.2.21.17.1 If not satisfied with this "MARK" reject it by entering VERB 52 into K148 or LEB DSKY. Press ENTR pushbutton and repeat step 6.2.21.17. If satisfied with the "MARK", press the ENTR pushbutton and proceed to 6.2.21.18.

6.2.21.18 Observe the following displays on the CRT and LEB DSKY: (R1, R2 and R3 contain the three misalignment angles).

VERB 06, NOUN 67 (FLASHING)
R1 ± XX.XXX (X Gyro Torquing Angle)
R2 ± XX.XXX (Y Gyro Torquing Angle)
R3 ± XX.XXX (Z Gyro Torquing Angle)

6.2.21.19 Enter the following into K148:

VERB 21 ENTR 00000 X set torq ∠ to 0
VERB 22 ENTR 00000 Y set torq ∠ to 0
VERB 33 ENTR

6.2.21.20 Observe and verify that the MAJOR MODE lights indicate 02 on the CRT and DSKY.

6.2.21.20.1 Wait two (2) hours before proceeding.

6.2.21.21 Repeat steps 6.2.21.9 through 6.2.21.18. Record the readings for the appropriate gyros in Table 6.2. (First Reading, Data Set #2).

6.2.21.21.1 Enter the following inputs into K148:

VERB 34 ENTR

6.2.21.22 Repeat steps 6.2.21.9 and 6.2.21.18 two (2) more times to obtain the second and third readings. Each time that 6.2.21.18 is completed, record the readings for the appropriate gyros in Table 6.2, and enter the following into K148:

VERB 34 ENTR

6.2.21.22.1 Calculate the average value of the three readings for each gyro and record in Table 6.2.

6.2.21.23 At 30 minute intervals perform steps 6.2.21.23.1 through 6.2.21.23.3 three times to obtain data sets 3 and 4.

6.2.21.23.1 Repeat steps 6.2.21.9 through 6.2.21.18.

6.2.21.23.2 Record the contents of R1, R2 and R3 for the appropriate gyros in Table 6.2.

6.2.21.23.3 Enter the following into K148:

VERB 34 ENTR

6.2.21.24 Calculate the average value of the three readings for each gyro in each data set. Record in Table 6.2.

6.2.21.24.1 The average values recorded in Table 6.2, data sets 2, 3 and 4 shall be:

± 0.05 degrees or less on X
± 0.05 degrees or less on Y
± 0.60 degrees or less on Z

6.2.21.24.2 The average values for data sets 3 and 4 shall not deviate from the average value for data set 2 by more than the following amounts:

± 0.02 degrees or less than X
± 0.02 degrees or less than Y
± 0.08 degrees or less than Z

NOTE: Coordinate the next steps with the test conductor before proceeding.

6.2.21.25 After recording data set 4, have the input voltage to the G&N system adjusted to 26.1 volts dc for a period of one hour.

6.2.21.25.1 The following lamps on Event Module 4A3A5E1 shall be lighted:

SIGNAL

a. 28 V DC AGC
b. 28 V DC OPERATE/IMU
c. 28V DC OPTICS

6.2.21.25.2 Record voltage readings on the CRT of the following signals on the data sheet:

	Measurement List No.	Signal	Requirement
a.	CG 1400	IMU 2.5 V 25.6 KC Supply	2.1 to 2.9 VRMS
b.	CG 1401	OPT 2.5 V 25.6 KC Supply	2.1 to 2.9 VRMS
c.	CG 1301	IMU 2 V 3200 CPS Supply	2.9 to 4.10 VRMS
d.	CG 1101	-28 VDC ELECTRONIC	-33.7 to -21.3 VDC
e.	CG 1030	+3 VDC AGC Supply	+1.88 to 4.12 VDC
f.	CG 1020	+13 VDC AGC Supply	+11.7 to +14.3 VDC
g.	CG 1201	IMU 28 V 800 CPS 1% 0°	27.0 to 29.9 VRMS
h.	CG 1203	IMU 28 V 800 CPS 5% 0°	24.7 to 30.3 VRMS
i.	CG 1202	IMU 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS
j.	CG 1204	CDU 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS
k.	CG 1211	OPT 28 V 800 CPS 1% 0°	27 to 29 VRMS
l.	CG 1212	OPT 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS

6.2.21.25.3 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times thirty minutes after adjustment of the G&N input voltage to 26.1 volts dc.

6.2.21.25.4 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times one hour after adjustment of the G&N input voltage to 26.1 volts dc. Record the data as data set 6 in Table 6.2 and calculate and record the average values.

6.2.21.26 Have the input voltage to the G&N system adjusted to 31.3 volts dc for a period of one hour.

6.2.21.26.1 The following lamps on Event Module 4A3A5E1 shall be lighted:

SIGNAL

a. 28 V DC AGC
b. 28 V DC OPERATE IMU
c. 28 V DC OPTICS

6.2.21.26.2 Record the voltage readings for the signals listed in 6.2.21.25.2. The requirements shall be those listed in 6.2.21.25.2.

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6.2.21.26.3 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times thirty minutes after adjustment of the G&N input voltage to 31.3 volts dc. Record the data as data set 7 in Table 6.2 and record the average values.

6.2.21.26.4 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times one hour after adjustment of the G&N input voltage to 31.3 volts dc. Record the data as data set 8 in Table 6.2 and calculate and record the average values.

6.2.21.27 Have the input voltage to the G&N system adjusted to 28 volts dc.

6.2.21.28 Enter the following into the K148:

```
VERB 37      ENTR
 00          ENTR
VERB 40      NOUN 20      ENTR wait 90 seconds
VERB 41      NOUN 20      ENTR
+00000       ENTR
+00000       ENTR
+00000       ENTR
```

6.2.21.29 Verify that COARSE ALIGN is the only mode lamp lighted on the IMU Control Panel.

6.2.21.30 Pull out OPTICS MNA and MNB breakers on Right Hand Circuit Breaker panel.

TABLE 6.1

Time	CDU Dial Readings		
Minutes	OG	IG	MG
0			
15			
30			
45			
60			
75			
90			
105			
120			
135			
150			
165			
180			
195			
210			
225			
240			
255			
270			
285			
300			

TABLE 6.2

Data Set	X Gyro Torquing Angle (R1)				Y Gyro Torquing Angle (R2)				Z Gyro Torquing Angle (R3)			
	First Reading	Second Reading	Third Reading	Average	First Reading	Second Reading	Third Reading	Average	First Reading	Second Reading	Third Reading	Average
1												
2 (2 hours)												
3 (2.5 hours)												
4 (3.0 hours)												
5 (Lo Bus)												
6 (Lo Bus)												
7 (Hi Bus)												
8 (Hi Bus)												

ADDENDUM NO. 1

This specification (ND1002326) shall be modified as shown below for use with Spacecraft 020.

1. Page 3, Change from: "MA 0308-0049 Component Installation Procedure Apollo Guidance Equipment S/C 017."
To: "MA 0308-0049 Component Installation Procedure-Apollo Guidance Equipment S/C 020."

2. Page 4, Change from: "SC 017, Block I, Series 100, Acceptance Data Package."
to: "SC 020 Block I Series 100, Acceptance Data Package."

3. Page 6, Paragraph 4.1, Item 20
Change from: "F04C017-K00012-XX"
to: "F04C020-K00012-XX"

4. Item 35
Change from: "F04C017-K00020-XX"
to: "F04C020-K00020-XX"

Item 36
Change from: "F04C017-K00031-XX"
to: "F04C020-K00031-XX"

Item 37
Change from: "F04C017-K00040-XX"
to: "F04C020-K00040-XX"

4. Page 12, paragraph 5.7.2
Change from: "...Specification MA 0308-0049 Mechanical Installation Specification for Apollo Guidance Equipment (S/C 017)"
to: "...specification MA 0308-0049 Mechanical Installation Specification for Apollo Guidance Equipment (S/C 020)"

5. Page 20, Paragraph 6.2.1.3.11
Change from: "F04C017-K00012-XX"
to: "F04C020-K00012-XX"

6. Page 27, Paragraph 6.2.2.2.13 and 6.2.2.2.14
Change from: "F04C017-K00012-XX"
to: "F04C020-K00012-XX"

7. Page 32, Paragraph 6.2.3.3.1
Change from: "F04C017-K00020-XX"
to: "F04C020-K00020-XX"

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ADDENDUM NO. 1 (Continued)

8. Page 75, Paragraph 6.2.15.1
Change from: "F04C017-K00031-XX"
to: "F04C020-K00031-XX"

9. Page 97, Paragraph 6.2.21.2
Change from: "F04C017-K00040-XX"
to: "F04C020-K00040-XX"

APOLLO G&N Specification
ND 1002326 Rev. B
Original Issue Date: 11/18/66
Release Authority: TDRR 32037
Class A **Release**

Post-Installation Checkout Process Specification
For The Apollo Guidance & Navigation System (Spacecraft 17 and 20, KSC)

Record of Revisions

Date	**Revision Letter**	**TDRR No.**	**Pages Revised**
2/13/67	A	32968	2,3,5-12,14,17-107, was 107 pages, now 113 pages. [illegible]
5/25/67	B	33867	1,2,7,8,11,15,16,19,22-106. Specification was 113 pages, now 106 pages. RDC/mc

This specification consists of page 1 to 106 inclusive.

APPROVALS	**NASA/MSC**		**ACED**

NUMBER	REVISION LETTER	PAGE

1. INTRODUCTION

1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one each of the following major assemblies:

Assembly Name	NAA Drawing No.
Equipment Install-Block I, Series 100 Guidance & Navigation, LWR Equip. Bay	V16-724019
Equip Install - Block I G&N Main Display Console	V16-724006

1.2 The G&N System herein shall be identified as a Block I, Series 100 G&N System. The computer contains the **SOLRUM 55** **programs in the core** rope memory modules.

2. SCOPE

2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module, Spacecraft 017 at Kennedy Spacecraft Center, Florida. This specification also outlines the checkout requirements for the G&N System installed in the Apollo Command Module, Spacecraft 020 at Kennedy Spacecraft Center, Florida, as modified by Addendum 1 to this specification.

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5. GENERAL REQUIREMENTS

5.1 Safety Requirements

5.1.1 Operator Safety

5.1.1.1 Normal safety precautions shall be observed throughout the G&N post-installation checkout.

5.1.2 Equipment Safety.

5.1.2.1 To preserve the operational life of the components of the G&N hardware under test, settings and adjustments shall be performed only when specified in the test procedure. Care shall be exercised in the accomplishment of all settings and adjustments to avoid excessive wear and damage to the equipment. All precautionary measures stated throughout the test procedures shall be strictly adhered to.

5.1.2.2 Prior to the electrical connection of the G&N System to the spacecraft harness, a complete verification of spacecraft power, to include both voltage polarity and magnitude, shall be completed to preclude damage to the G&N due to incorrect power application.

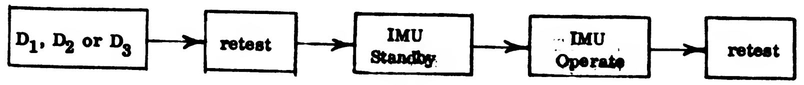
5.1.2.3 In no event shall the ICTC be disconnected from PSA Tray 7 except when specified to do so in a specific test.

5.1.2.4 The generation of noise alarm indication, as evidenced by one or more Noise Peak Event lamps becoming lighted shall be cause for immediate determination of effects on G&N System Test in progress. In the event of detrimental effects on the system test, a troubleshooting routine shall be entered to determine the cause of the alarm. Testing shall continue only after demonstrating that the cause of the noise alarm has been located and that remedial action has been or will be taken, or that the transient or noise causing the alarm has no detrimental effect on the G&N System test in progress.

5.1.2.5 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as non-conforming. Normal test sequence may be continued upon determination of the cause of the non-conformance or at the discretion of the G&N contractor test team if not detrimental to the G&N System or other interfacing subsystems. All non-conformances shall be investigated and cleared by waiver (F.N.N.), correction of specification, or hardware replacement and retest. The suspected malfunctioned hardware shall be removed and returned to the laboratory where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable element be installed in the G&N System.

5.1.2.5.1 Inertial Component Stability Failure.

5.1.2.5.1.1 If D_1, D_2, or D_3 exceeds the maximum values as indicated in 6.2.18.5.3.2, 6.2.18.5.4.2, and 6.2.19.24 for any PIPA or IRIG: that PIPA or IRIG shall be retested in the sequence indicated below. The coefficient stability terms shall then be recalculated.



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If D_1, D_2, and D_3 are within tolerance specified after retest, the original out of tolerance terms shall be exonerated.

If D_1, D_2, or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.1.2.5.1.1.1 shall apply. 5.1.2.5.1.1.2 ([illegible]) shall apply.

5.1.2.5.1.1.1 Stability requirements. Failure to be within the maximum values of D_1, D_2, and D_3 after the retest sequence of 5.1.2.5.1.1 shall constitute a failure of the assembly.

5.2 Standard Environmental Conditions

5.2.1 The G&N System when installed in the Command Module shall be tested in an environment in accordance with ICD MH01-1248-416. At no time shall the dust particle count exceed level 300,000 of Federal Standard 209 with no more than 2,000 particles per cubic foot larger than 5 microns; no more than 35 particles larger than 65 microns with no more than 3 of these 35 larger than 100 microns in existance. Dust covers shall be installed on the SXT and SCT per ICD MH01-01250-116 when optics are not under test.

5.2.2 The Apollo G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD MH01-01249-416.

5.3 Test Equipment Tolerances

5.3.1 All tolerances specified herein do not include instrumentation uncertainties.

5.4 Test Sequence

5.4.1 The test Sequence normally should follow the steps outlined by Code numbers in Figure I in the order specified. This normal order can be deviated on approval by the G&N Steering Committee.

5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the subassembly in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading or as directed by NASA Test Engineering. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I. It must be noted that Table II is to be used only as a guide.

TABLE II. RETEST MATRIX

Paragraph Number	IMU	OPTICS & NAV BASE	AGC	PSA TRAY 1	PSA TRAY 2	PSA TRAY 3	PSA TRAY 4	PSA TRAY 5	PSA TRAY 6	PSA TRAY 7	PSA TRAY 8	PSA TRAY 9	PSA TRAY 10	G&N DSKY	MDC DSKY	D&C ELEC;	SIG COND	OCDU'S	ICDU'S	G&N HARNESS	GNIC PANEL
6.1.3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.1.3.9			X																		
6.2.1	X	X	X	X	X					X			X				X			X	
6.2.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6.2.3		X	X											X	X					X	
6.2.4	X	X	X	X	X				X	X			X			X	X	X	X	X	
6.2.5	X	X																		X	
6.2.6	X	X	X	X	X	X	X	X	X	X										X	
6.2.7	X	X		X						X										X	X
6.2.8		X	X																	X	
6.2.9		X												X	X	X	X	X	X	X	X
6.2.10		X	X						X		X	X					X	X		X	
6.2.11		X							X		X	X	X					X		X	X
6.2.12		X									X	X						X		X	X
6.2.13		X			X				X	X	X	X						X		X	X
6.2.14	X	X	X	X	X			X	X	X						X	X		X	X	
6.2.15	X	X			X	X	X													X	
6.2.16	X	X		X													X			X	
6.2.17	X	X		X	X	X	X	X												X	
6.2.18	X	X		X		X	X	X	X	X									X	X	
6.2.19	X	X		X		X														X	
6.2.20	X	X		X		X	X	X	X	X									X	X	
6.2.21	X	X			X					X										X	

6.2.21.22 Repeat steps 6.2.21.9 and 6.2.21.18 two (2) more times to obtain the second and third readings. Each time that 6.2.21.18 is completed, record the readings for the appropriate gyros in Table 6.2, and enter the following into K148:

VERB 34 ENTR

6.2.21.22.1 Calculate the average value of the three readings for each gyro and record in Table 6.2.

6.2.21.23 At 30 minute intervals perform steps 6.2.21.23.1 through 6.2.21.23.3 three times to obtain data sets 3 and 4.

6.2.21.23.1 Repeat steps 6.2.21.9 through 6.2.21.18.

6.2.21.23.2 Record the contents of R1, R2 and R3 for the appropriate gyros in Table 6.2.

6.2.21.23.3 Enter the following into K148:

VERB 34 ENTR

6.2.21.24 Calculate the average value of the three readings for each gyro in each data set. Record in Table 6.2.

6.2.21.24.1 The average values recorded in Table 6.2, data sets 2, 3 and 4 shall be:

± 0.05 degrees or less on X
± 0.05 degrees or less on Y
± 0.60 degrees or less on Z

6.2.21.24.2 The average values for data sets 3 and 4 shall not deviate from the average value for data set 2 by more than the following amounts:

± 0.02 degrees or less than X
± 0.02 degrees or less than Y
± 0.08 degrees or less than Z

NOTE: Coordinate the next steps with the test conductor before proceeding.

APOLLO G&N Specification
ND 1002326 Rev. C
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Class A Release

Post-Installation Checkout Process Specification
For The Apollo Guidance & Navigation System (Spacecraft 17 and 20, KSC)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised
2/13/67	A	32968	2,3,5-12,14,17-107, was 107 pages, now 113 pages.
5/25/67	B	33867	1,2,7,8,11,15,16,19,22-106. Specification was 113 pages, now 106 pages.
9/29/67	C	34781	8, 15, 16, 25, 36, 38-40, 45, 61, 62, 64, 67, 73-74

This specification consists of page 1 to 106 inclusive.

APPROVALS	NASA/MSC		AC

5.13 Optics Power Turn On Procedure for Optical GSE Alignment Test.

5.13.1 The Optical GSE Subsystem Alignment Test must be completed before proceeding with the following tests:

a. 6.2.13 Optic Positional Accuracy Test
b. 6.2.20 Fine Alignment Test
c. 6.2.21 Gyro Compassing Test
d. 6.2.18 PIPA Scale Factor Determination Test
e. 6.2.19 IRIG Coefficient Determination Test

5.13.2 The G&N Optics Turn On procedure for Optical GSE Subsystem Alignment Test may be performed at anytime in the tests in Table I, 6.2.1 through 6.2.9, except for those sequences requiring OPTICS or LIGHTING main power shutdown. Optics power shall only be applied during those tests requiring measurement of optics parameters.

5.13.3 G&N Optics Power Turn-ON

5.13.3.1 Insure that the SXT and SCT eyepieces are installed properly on the G&N Optics base. The optics switches and selectors on the G&N Indicator Control Panel shall be set to the following positions:

a. SLAVE TELESCOPE to STAR LOS
b. OPTICS MODE to MANUAL
c. CONTROLLER MODE to DIRECT
d. CONTROLLER SPEED to LO
e. POWER and BRIGHTNESS to ON
f. PANEL BRIGHTNESS to maximum increase

5.13.3.2 Place or verify that the LIGHTING AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON position. (Breakers pushed in).

5.13.3.3 Place the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel to ON position. (Breakers pushed in).

5.13.3.4 Verify that the OPTC [illegible] on the Condition Annunciator Panel is lighted for no more than [illegible] seconds after optics power turn on.

5.13.3.4 OPTICS +28 VDC DISCRETE shall be issued (CG1533) by observing that the OPTICS lamp on the Event Module is lighted.

5.13.3.5 Sight through the SXT eyepiece to verify that the optical reticles are illuminated.

5.13.3.6 Verify that the optics supply voltage listed below appear on the CRT:

a. CG 1401 OPTX 2V 25.6 KC Supply in PH +2.1 to 2.9 VRMS

b. CG 1211 OPTX 28V .8 KC 1% DEG supply +27 to 29 VRMS

c. CG 1212 OPTX 28V .8 KC 5%-90 supply +26.1 to 29.9 VRMS

5.13.3.7 Ensure that the optics GSE, Optics Support Fixture, Model No. A14-135, has been properly installed.

5.13.3.8 Proceed with the Optical GSE Subsystem Alignment Test in accordance with OCPK021.

5.14 There are requirements in 6.2.7 IMU Temperature Control Test, 6.2.18 PIPA Scale Factor Determination Test, and 6.2.19 IRIG Coefficient Determination Test that must be obtained from the Acceptance Data Package. The aforementioned data, which fulfilled the requirements, shall be available prior to checkout of the G&N System.

6.2.1.3.9 Verify that the AGC is in the Backup Mode by monitoring on CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

6.2.1.3.10 Obtain E Memory Zeroing Tape No. F04C017-K00012-XX and load the tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AGC memory locations.

6.2.1.3.11 Run the remaining portion of tape to initiate AGC Self Test. Wait approximately three minutes.

6.2.1.3.11.1 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT +1 and SCOUNT +2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67±2 seconds. Monitor R1, R2, and R3 until R1 equals 00003, and R2 and R3 equal 00002.

6.2.1.4 Standby Power Temperature Control Loop Tests.

6.2.1.4.1 Enter the IMU Standby Mode of Operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in). Record range time.

6.2.1.4.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted. (CG 1513)

6.2.1.4.3 Set ICTC Power ON-OFF switch to ON position.

6.2.3.2.2.1 Press ERROR RESET and KEY RELEASE pushbuttons. The KEY RELEASE and AGC alarm lamps shall not be lighted.

6.2.3.2.3 DSKY Pushbutton Check

6.2.3.2.3.1 Enter VERB 25, NOUN 02 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.2 Enter 01775 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.3 Enter +00123 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.4 Enter -00456 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.5 Enter -00789 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.6 Verify that +00123 is displayed in R1, -00456 is displayed in R2 and -00789 is displayed in R3 in the LEB and MDC AGC DSKY's.

6.2.3.2.3.7 Enter VERB 05, NOUN 02 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.8 Enter 01775 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.9 The LEB and MDC AGC DSKY's shall indicate 00173 in R1, 77067 in R2, and 76352 in R3. Verify the displays.

6.2.3.2.3.10 Repeat 6.2.3.2.3.1 through 6.2.3.2.3.9 using the MDC AGC DSKY.

6.2.3.2.4 C-Relay Check

CAUTION

Ensure that the Mission Control Programmer circuit breakers AUX BUS A MCP1 and MCP2, AUX BUS B MCP1 and MCP2 and POST LDG MCP of the Auxiliary DC Power Control Box are in the OFF positions.

> NOTE: ACCEL FAIL, IMU FAIL, CDU FAIL and ZERO ENCODER lamps on Condition Annunciator panel will light intermittently during this test. Ignore KEY RELEASE light until directed to press KEY RELEASE.

6.2.3.2.4.1 Enter the following sequence into MDC or LEB AGC DSKY to initiate the C-Relay Test:

a. VERB 15 NOUN 01 ENTER
b. 00723 ENTER
c. VERB 57 ENTER
d. 00006 ENTER

6.2.3.2.4.2 Press KEY RELEASE pushbutton after KEY RELEASE lamp lights. Rows R1, R2 and R3 shall display the contents of DSPTAB +11D, (R1), DSPTAB +12D, (R2), DSPTAB +13D, (R3).

6.2.3.3.4.4 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.

6.2.3.3.4.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.6 Verify R1 indicates00003 on CRT.

6.2.3.3.4.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.8 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.

6.2.3.3.5 TC Trap (Due to constant TC instruction or an extended period without a TC instruction being generated)

6.2.3.3.5.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.2 Verify R1 indicates 00004 on CRT.

6.2.3.3.5.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.4 The TC TRAP alarm light shall be lighted. Verify indications on the LEB DSKY and Event Module (CG 5029). Press ERROR RESET pushbuttons.

6.2.3.3.5.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.6 Verify R1 indicates 00005 on CRT.

6.2.3.3.5.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.8 The TC TRAP alarm light shall be lighted. Verify indication on LEB DSKY and Event Module (CG 5029). Press ERROR RESET.

6.2.3.3.6 PGNS CAUTION alarm generated by Nightwatchman program alarm.

6.2.3.3.6.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.6.2 Verify R1 indicates 00006 on CRT.

6.2.3.3.6.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.6.4 Verify the PGNS caution lamp on Condition Annunciator panel lights within 3 seconds after tape stops. Error lamp on Panel 10 light within 3 seconds after tape stops and that the G&N ERROR lamp lights for only 2 to 3 seconds. Press Error Reset pushbutton.

6.2.3.3.7 Check Fail indications.

6.2.3.3.7.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.7.2 Verify R1 indicates 00007 on CRT.

6.2.3.3.7.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.7.4 Verify CHECK FAIL alarm indications on LEB DSKY and Event Recorder (CG 5023) and the PGNS lamp is lighted.

6.2.3.3.7.5 Press ERROR RESET on DSKY.

6.2.3.3.8 Program Alarm indication

6.2.3.3.8.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.8.2 Verify R1 indicates +00008 on CRT.

6.2.3.3.8.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.8.4 Verify Program Alarm indication on LEB DSKY and Event Recorder (CG 5020) and that PGNS lamp is lighted.

6.2.3.3.8.5 Press ERROR RESET on DSKY.

6.2.3.3.9 TELEMETRY FAIL ALARM

6.2.3.3.9.1 Press RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.9.2 Verify that R1 displays +00009 on the CRT.

6.2.3.3.9.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.9.4 Verify that the TELEMETRY FAIL alarm is illuminated in the MDC and the LEB DSKY.

6.2.3.3.9.5 Verify that SEAL is indicated on the K-START module. Press ERROR RESET to clear AGC DSKY's.

6.2.3.3.9.6 Insert Verb 36 and ENTER into LEB DSKY. Insert VERB 21 NOUN 02 and ENTER into LEB DSKY. Insert 00041 and ENTER into LEB DSKY. Insert 00000 and ENTER into LEB DSKY.

6.2.3.3.10 PARITY FAIL

6.2.3.3.101 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.102 Verify that R1 indicates +00010 on CRT.

6.2.3.3.103 Press the RUN indicator on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.104 Verify that PARITY ALARM has been generated and displayed on the MDC and the LEB DSKY's and that the EVENT MODULE is lighted. Disregard all or any other alarm indications. Press ERROR RESET.

6.2.3.4 BANK SUM TEST

6.2.3.4.1 Press ERROR RESET pushbutton and enter VERB 36 into K148, press ENTER pushbutton. Press ERROR RESET pushbutton.

6.2.3.4.2 Enter VERB 56 into K-148, press ENTER pushbutton.

6.2.3.4.3 Verify R1 = R2 = 00002 on CRT.

6.2.3.4.4 Enter VERB 33 into K-148, press ENTER pushbutton.

6.2.3.4.5 Verify R1 = R2 = 000XX on CRT.

6.2.3.4.6 Repeat 6.2.3.4.4 and 6.2.3.4.5 until R1 = R2 = 00034.

6.2.3.4.7 Enter VERB 34 into K-148, press ENTER pushbutton.

6.2.4.10.2 Record the noise peaks of the following signals displayed on the CRT:

Item No.	Meas'mt No.	Signal	Requirement
a.	CG 1001	+120 VDC IRIG NOISE RMS	Less than ±1.00VRMS
b.	CG 1011	+120 VDC PIPA NOISE RMS	Less than ± 1.0 VRMS
c.	CG 1021	+ 13 VDC AGC NOISE RMS	Less than 0.65 VRMS
d.	CG 1031	+ 3 VDC AGC NOISE RMS	Less than 0.65 VRMS
e.	CG 1501	+ 28 VDC No. 1 NOISE RMS	Less than ± 0.70 VRMS
f.	CG 1511	+ 28 VDC No. 2 NOISE RMS	Less than ± 0.70 VRMS
g.	CG 1521	+ 28 VDC No. 3 NOISE RMS	Less than ± 0.70 VRMS
h.	CG 1531	+ 28 VDC No. 4 NOISE RMS	Less than ± 0.70 VRMS

6.2.4.10.3 Record the phase difference of the following signals displayed on the CRT:

a.	CG 1206	PH DIF IMU 1% 0°, IMU 5% 90°	-77.0 to -103°
b.	CG 1207	PH DIF IMU 5% 0°, IMU 5% 90°	-77.0 to -103°
c.	CG 1306	PH DIF IMU 2V 3.2KC AGC SYNC	-12.5 to +12.5°
d.	CG 1209	PH DIF IMU 1% 0° CDU 5% 90°	-77 to -103°
e.	CG 1220	PH DIF IMU 1% 0° OPTX 1% 0°	-12.5 to +12.5°
f.	CG 1402	PH DIF IMU 25.6KC OPTX 25.6KC	-32 to +32°
g.	CG 1216	PH DIF OPTX 1% 0° OPTX 5% 90°	-77 to -103°

6.2.4.10.4 The noise peaks of the following signals are demonstrated on the event lights when the peak voltage exceeds 5 volts and is present for more than one microsecond.

			Event Module
a.	CG 1022	+13 VDC AGC NOISE PEAK	4A3-A5
b.	CG 1032	+ 3 VDC AGC NOISE PEAK	4A3-A5
c.	CG 1502	+28 VDC No. 1 NOISE PEAK	4A3-A5
d.	CG 1512	+28 VDC No. 2 NOISE PEAK	4A3-A5
e.	CG 1522	+28 VDC No. 3 NOISE PEAK	4A3-A5
f.	CG 1532	+28 VDC No. 4 NOISE PEAK	4A3-A5

6.2.4.10.5 Optics power shall be removed by actuating the G&N OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel to off. (breakers pulled out)

6.2.4.10.6 Perform 6.2.6 G&N Operational Test.

6.2.4.10.7 Record the following signals displayed on the CRT.

MEAS NO.	SIGNAL	REQUIREMENT
a. CG 4300	AGC TEMP	40°F to 105°F
b. CG 6000	IMU PRESSURE	13.0 PSI to 15.0 PSI
c. CG 6020	PSA TEMP 1, TRAY 3	40°F to 93°F
d. CG 6021	PSA TEMP 2, TRAY 4	40°F to 93°F

6.2.11.4.10 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.4.11 The Shaft slew rate shall be 17.0±3.4 degrees/second.

6.2.11.5 Slew Rate - Medium Speed

6.2.11.5.1 Set up Analog Recorders to measure the following signals at the location specified:

a.	CG 3141 TRUN CDU 16X RES ERROR	4A1-A3-7-0
b.	CG 3120 SCT TRUN 1X RES ERROR	4A1-A2-8-0
c.	CG 3211 SHAFT CDU 16X RES ERROR	4A3-A2-8-2

6.2.11.5.2 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to MED.

6.2.11.5.3 Drive the optics with the OPTICS CONTROL STICK until the SHAFT and 2X TRUNNION CDU's indicate 0° ±1°.

6.2.11.5.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 am/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2 andR3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.5 Record the value of signals specified in 6.2.11.5.1.

CG3120 SCT TRUN 1X RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2, and R3 displays when the "MARK" pushbutton is pressed are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

6.2.11.5.6 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.5.4 as Δ Trun, and Δ Time. Record the maximum value of signal A specified in 6.2.11.5.1. The maximum steady state value of CG 3141 trun CDU 16X res error shall be no greater than ±6.0 mv.

6.2.11.5.7 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.5.8 The Trunnion slew rate shall be 1.0±0.2 degrees/seconds.

6.2.11.5.9 Drive the optics with the OPTICS CONTROL STICK until the SHAFT and 2X TRUNNION CDU's indicate 0° ±1°.

6.2.11.5.10 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.11 Record the value of the following signal on the CRT.

CG3131 SCT SHAFT 1X RES ERROR shall be less than 0.20 VRMS

NOTE: The R1, R2 and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

6.2.11.5.12 Compute the respective differences between the R1, and R3 displays recorded in 6.2.11.5.10 as Δ Shaft, and Δ Time.

6.2.11.5.13 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{Shaft}}{\Delta \text{ Time}}$$

Record the maximum steady state value of signal D specified in 6.2.11.5.1. The maximum value of CG 3211 shaft CDU 16X res error shall be no greater than ±6.0 mv.

6.2.11.5.14 The Shaft slew rate shall be 2.0±0.4 degrees/second.

6.2.11.6 Slew Rate - Low Speed

6.2.11.6.1 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to LO.

6.2.11.6.2 Drive the optics with the OPTICS CONTROL STICK until the SHAFT and 2X TRUNNION CDU's indicate 0° ±1°.

6.2.11.6.3 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.13 The Shaft slew rate shall be 0.2±0.04 degrees/second.

6.2.11.7 AGC Optics Slewing

6.2.11.7.1 Drive the optics with the OPTICS CONTROL STICK until the SHAFT and 2X TRUNNION CDU's indicate 0° ±1°. Wait until the ZERO ENCODER lamp has extinguished before proceeding. [illegible]

6.2.11.7.2 Set up the Analog Recorder 4A3-A2 to monitor the following signals:

a.	CG3105, SXT TRUNNION TACH FEEDBACK	4A3-A2-1-3
b.	CG3115, SXT SHAFT TACH FEEDBACK	4A3-A2-7-1
c.	CG3134, SCT TRUNNION TACH FEEDBACK	4A3-A2-4-3
d.	CG3124, SCT SHAFT TACH FEEDBACK	4A3-A2-3-2

6.2.11.7.3 Enter the following sequence into K148:

a. VERB 21 NOUN 01 ENTER
b. 00724 ENTER
c. 40000 ENTER
d. VERB 41 NOUN 55 ENTER
e. +27000 [illegible] ENTER
f. +60000 [illegible] ENTER

6.2.11.7.4 Start the Analog Recorder at 10 mm/sec and rotate OPTICS MODE selector to COMPUTER. Wait until the transients have died out and stop the Analog Recorder. Record the elapsed time for each signal in 6.2.11.7.2 to reach its final value. In all cases, the elapsed time for the signals in 6.2.11.7.2 shall be less than 50 sec.

6.2.11.7.5 Record the SHAFT and 2X TRUNNION CDU dial indications. The SHAFT CDU shall read 270.0±0.022 degrees. The 2X TRUNNION CDU shall read 120.00±0.01 degrees.

6.2.11.7.6 Drive the optics with the OPTICS CONTROL STICK until the SHAFT and 2X TRUNNION CDU's indicate 0° ±1°.

6.2.11.7.7 Verify that G&N System is in the Coarse Align Mode under Computer control.

6.2.13 Optics Positional Accuracy Test

6.2.13.1 Proceed with this test if 6.2.4, Operate Power On Test, or 6.2.2.2, Turn On Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn On Procedure before proceeding.

NOTE: This test requires the use of G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both autosets are visible through the SXT StLOS in accordance with OCPK 021. [illegible].

Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.13.2 G&N System shall be in COARSE ALIGN MODE under AGC control. Optics operate power shall be applied by pushing in the OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker panel.

6.2.13.3 Optics controls on the G&N Indicator Control Panel shall be set as follows:

a. CONTROLLER SPEED - LOW
b. CONTROLLER MODE - DIRECT
c. SLAVE TELESCOPE - STAR LOS
d. OPTICS MODE - MANUAL

NOTE: When directed to use Control Stick to drive optics, set CONTROLLER SPEED selector to position desired and drive optics. Always return selector to LOW position to prevent excessive LOS drift.

6.2.13.4 Resolution Checks

6.2.13.4.1 Drive the optics with the OPTICS CONTROL STICK until the SHAFT and 2X TRUNNION CDU's indicate 0° ±1°.

6.2.13.4.2 Sight on the 5-inch Autocollimator, through the SXT eyepiece. Using the CONTROL STICK to drive the SXT to the approximate position, adjust the TRUNNION and SHAFT ANGLE to view the autocollimator resolution pattern at the center of the field of view.

6.2.13.4.3 Note that the 5-inch autocollimator resolution pattern contains a series of lines of different thickness and width. Each set of lines is marked with a numeral (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space in seconds of arc. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines.

6.2.14.5 Coarse Align Mode

6.2.14.5.1 Enter VERB 41, NOUN 20 into K-148. Press the ENTER pushbutton.

6.2.14.5.2 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.3 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.4 Enter +00000 into K-148. Press the ENTER pushbutton. Wait 60 seconds.

NOTE: The PGNS lamp will light on the Condition Annunciator Panel. Disregard lamp indication.

6.2.14.5.5 Set up the Analog Recorder 4A3-A2 to monitor the following signals:

Signal
a. CG 2110 IGA TORQUE MOTOR INPUT
b. CG 2140 MGA TORQUE MOTOR INPUT
c. CG 2170 OGA TORQUE MOTOR INPUT

6.2.14.5.6 Enter (and verify) VERB 41, NOUN 20 (COARSE ALIGN) into K-148. Press ENTER pushbutton.

6.2.14.5.7 Enter +06000 into K-148 twice. Press ENTER pushbutton after each entry.

6.2.14.5.8 Start Analog Recorder 4A3-A2. Enter +06000 into K-148. Press ENTER pushbutton.

NOTE: The GIMBAL LOCK lamp on the Condition Annunciator and PROGRAM alarm lamp on LEB DSKY may light. Press ERROR RESET pushbutton and continue.

6.2.14.5.9 After the transients have died out, stop Analog Recorder 4A3-A2. Determine the time elapsed on each signal specified in 6.2.14.5.5 between the initial and final transients. Record elapsed times. The elapsed times for IGA, OGA, and MGA to drive from zero degrees to 60 degrees shall be no greater than 21 seconds.

6.2.14.5.9.1 The following gimbal angles as read out on the CRT shall be 060.0±1.0 degrees.

	GIMBAL ANGLES		DEGREE
CG 2172	OGA 1X RES OUTPUT SIN	-OUTER	060.0±1.0°
CG 2173	OGA 1X RES OUTPUT COS		
CG 2112	IGA 1X RES OUTPUT SIN	-INNER	060.0±1.0°
CG 2113	IGA 1X RES OUTPUT COS		
CG 2142	MGA 1X RES OUTPUT SIN	-MIDDLE	060.0±1.0°
CG 2143	MGA 1X RES OUTPUT COS		

6.2.14.5.10 Verify that the K Relays on CRT indicate 000010. Record.

6.2.14.5.11 Record IMU-CDU DIFFERENCE meter indications for the INNER, MIDDLE, and OUTER GIMBAL channels. The INNER, MIDDLE, and OUTER indicators in the IMU-CDU DIFFERENCE meter shall be 0±1.0 degrees.

6.2.14.5.12 Record the indicated value of the following signals in Table VII on the CRT.

Table VII Signal Voltage Requirements

	Signals	Requirements
1.	CG 2206 IGA CDU IX RES ERROR	0.0 to .210 VRMS
2.	CG 2236 MGA CDU IX RES ERROR	0.0 to .210 VRMS
3.	CG 2266 OGA CDU IX RES ERROR	0.0 to .210 VRMS
4.	INNER GIMBAL ANGLE	60±2.5 degrees
5.	MIDDLE GIMBAL ANGLE	60±2.5 degrees
6.	OUTER GIMBAL ANGLE	60±2.5 degrees
7.	CG 2209 SCS PITCH	0.0±1.00 degrees
8.	CG 2239 SCS YAW BODY AXIS	0.0±1.00 degrees
9.	CG 2241 SCS YAW OFFSET AXIS	0.0±1.00 degrees
10.	CG 2269 SCS ROLL BODY AXIS	0.0±1.00 degrees
11.	CG 2271 SCS ROLL OFFSET AXIS	LLL to UUU degrees

6.2.14.6 Fine Align Mode

NOTE: The Program Alarm and GIMBAL LOCK indication may be present during the duration of the FINE ALIGN Mode test.

6.2.14.6.1 Enter (and verify) VERB 42 into K-148. Press ENTER pushbutton to advance G&N to the FINE ALIGN mode. The VERB-NOUN display shall indicate 21-67 flashing.

6.2.14.6.2 Enter +00000 three times pressing ENTER pushbutton after each entry into K-148. Press ENTER pushbutton. Verify VERB-NOUN display shall stop flashing. The FINE ALIGN MODE lamp on the IMU CONTROL Panel is the only MODE lamp that is lighted.

6.2.14.6.3 Record the indicated values of the following signals in Table VIII on the CRT.

Table VIII Voltage Requirements

	Signals	Requirements
a.	CG 2204 IGA CDU 16X RES ERROR	0.0 to .125 VRMS
b.	CG 2234 MGA CDU 16X RES ERROR	0.0 to .125 VRMS
c.	CG 2264 OGA CDU 16X RES ERROR	0.0 to .125 VRMS
d.	CG 2107 OGA SERVO ERROR	0.0 to .23 VRMS
e.	CG 2137 MGA SERVO ERROR	0.0 to .23 VRMS
f.	CG 2167 OGA SERVO ERROR	0.0 to .23 VRMS

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Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised

This specification consists of page 1 to 107 inclusive.

APPROVALS	NASA/MSC		ACED

1. INTRODUCTION

1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one each of the following major assemblies:

Assembly Name	NAA Drawing No.
Equipment Install-Block I, Series 100 Guidance & Navigation, LWR Equip. Bay	V16-724013
Equip Install - Block I G&N Main Display Console	V16-724006

1.2 The G&N System herein shall be identified as a Block I, Series 100 AGE 122 System. The computer contains the SOLARIUM programs in the core rope memory modules.

2. SCOPE

2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module, Spacecraft 017 at Kennedy Spacecraft Center, Florida. This specification also outlines the checkout requirements for the G&N System installed in the Apollo Command Module, Spacecraft 020 at Kennedy Spacecraft Center, Florida, as modified by Addendum 1 to this specification.

NUMBER	REVISION LETTER	PAGE

3. APPLICABLE DOCUMENT

3.1 Documents required by this specification.

3.1.1 When the requirements of this specification conflict with the drawing requirements, the drawing requirements shall have precedence.

ATP 1026000	Pre-installation Assembly Test Procedure for the Apollo Guidance and Navigation System, P/N 1015000, Block I, Series 100
FTM 1026000	Final Test Method for G&N System
ICD MH01-01220-216	Interconn Diagram - AGC to AGC DSKY (Main Display Panel)
ICD MH01-01224-416	Attitude Error Signals
ICD MH01-01225-416	Total Attitude Signals
ICD MH01-01226-200	Central Timing Equipment Sync. Pulse
ICD MH01-01227-216	G&N Electrical Input Power
ICD MH01-01228-416	G&N Data Transmission to Operational PCM-Telemetry Equipment
ICD MH01-01236-200	ACE Uplink/SC Digital Up-DATA Link AGC
ICD MH01-01237-216	G&N Hold Attitude
ICD MH01-01242-416	G&N Condition & Display Lights
ICD MH01-01249-416	G&N Thermal Requirement
SID 63 517	Apollo Command Module/Service Module Measurement Requirements for SC 017 and 020.
MA0201-0499	ACE S/C Computer Subprogram
MA 0308-0047	Component Installation Procedure - Apollo Guidance Equipment S/C 017
MA0201-3179	Post Installation Checkout Process Specification for PIPA Scale Factor Determination - Apollo Guidance and Navigation System (Confidential Spec)

3.1.1 (Continued)

MA0610-018A	Contamination Control - Apollo Command Module and Service Module
MA0201-5036	Alignment of Optical Target GSE on Spacecraft
SC 017, Block I, Series 100, AGE	Acceptance Data Package
ICD MH01-01250-116	Installation Fixtures and Procedures

4. MATERIAL AND EQUIPMENT

4.1 The following test equipment shall be used to perform the requirements of this specification. If protection to personnel and equipment is not decreased, items except government furnished parts, equivalent to those listed may be used.

Item	Quantity	Description
1	1	Carry-on Receiver and Baseplate Unit,
2	1	Carry-on Baseplate Unit, Model No. C14-201
3	1	Junction Box ACE S/C Carry-on, Model No. C14-202
4	1	Carry-on ACE S/C Response System Support Rack, Model No. C14-203
5	1	Support Frame Carry-on DTCS, Model No. C14-204
6	1	Carry-on PCM System, Model No. C14-210
7	1	Digital Signal Conditioner and Multiplexing Unit, Model No. C14-211
8	1	G&N Signal Conditioner and Switching Matrix, Model No. C14-213
9	1	External Digital Test Command Unit, Model No. C14-241
10	1	Data Interleaver System, Model No. C14-232
11	1	S/C Ground Power Supply, Model No. C14-418
12	1	Breakout Box - Test C/M-S/M Adapter, Model No. C14-467
13	1	Electrical Cable Set, Model No. C14-478
14	1	PSA Tray Extender Set 1900806-011, Model No. A23-100
15	1	PSA Test Point Adapter, Model No. A23-167

4.1 (continued)

Item	Quantity	Description
16	1	Inertial Components Temperature Controller (ICTC) Model No. S23-100
17	1	PSA Adapter Module, Model No. A23-201
18	1	Volt Ohmeter Simpson, Model No. 269 or equivalent
19	1	Calculator (Friden or equivalent)
20	1	E-Memory Zeroing Tape No. F02C017-K00012-XX *
21	1	Stopwatch
22	1	Shorting Plug No. 45A7P2
23	1	Electrical Cable Portable G&N System, Model No. C14-462
24	1	Optics Supporting Fixture, Model No. A14-135
25	1	G&N Installation Qualification Fixture, Model No. A23-097
26	1	SCT Resolution Check Card
27	1	DKM-3 Theodolite
28	1	Retroflecting Prism 1019840, Model No. A23-200
29	1	Movable Optics Target
30	1	Portable Light Assembly (Light Scanning Telescope)
31	1	Electronic Counter with Preset Counter (Hewlett-Packard 5245L with 5264A Preset or equivalent)
32	1	Flexible Driver TM-62A (or equivalent)
33	1	Hex Head Cap Screwdriver TM AL-5 (5/32 Hex) (or equivalent)
34	1	Carry-on Cable Set C14-574
35	1	AGC Alarms and Interrupts Test Tape, No. F02C017-K00020-XX *
36	1	Gimbal Friction Test Tape No. F02C017-K00031-XX *
37	1	Flt Rope Cont Sim Flt Tape F02C-017-K00040-XX *

* - XX signifies revision of tape. Use latest revision for testing purposes.

5. GENERAL REQUIREMENTS

5.1 Safety Requirements

5.1.1 Operator Safety

5.1.1.1 Normal safety precautions shall be observed throughout the G&N post-installation checkout.

5.1.2 Equipment Safety

5.1.2.1 To preserve the operational life of the components of the G&N hardware under test, settings and adjustments shall be performed only when specified in the test procedure. Care shall be exercised in the accomplishment of all settings and adjustments to avoid excessive wear and damage to the equipment. All precautionary measures stated throughout the test procedures shall be strictly adhered to.

5.1.2.2 Prior to the electrical connection of the G&N System to the spacecraft harness, a complete verification of spacecraft power, to include both voltage polarity and magnitude, shall be completed to preclude damage to the G&N due to incorrect power application.

5.1.2.3 In no event shall the ICTC be disconnected from PSA Tray 7 except when specified to do so in a specific test.

5.1.2.4 The generation of noise alarm indication, as evidenced by one or more Noise Peak Event lamps becoming lighted shall be cause for immediate determination of effects on G&N System Test in progress. In the event of detrimental effects on the system test, a troubleshooting routine shall be entered to determine the cause of the alarm. Testing shall continue only after demonstrating that the cause of the noise alarm has been located and that remedial action has been or will be taken, or that the transientor noise causing the alarm has no detrimental effect on the G&N System test in progress.

5.1.2.5 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as non-conforming. Normal test sequence may be continued upon determination of the cause of the non-conformance or at the discretion of the G&N contractor test team if not detrimental to the G&N System or other interfacing subsystems. All non-conformances shall be investigated and cleared by waiver (F.N.N.), correction of specification, or hardware replacement and retest. The suspected malfunctioned hardware shall be removed and returned to the laboratory where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable element be installed in the G&N System.

5.2 Standard Environmental Conditions

5.2.1 The G&N System when installed in the Command Module shall be tested in an environment in accordance with ICD MH01-1248-416. At no time shall the dust particle count exceed level 300,000 of Federal Standard 209 with no more than 2,000 particles per cubic foot larger than 5 microns; no more than 35 particles larger than 65 microns with no more than 3 of these 35 larger than 100 microns in existance. Dust covers shall be installed on the SXT and SCT per ICD MH01-01250-116 when optics are not under test.

5.2.2 The Apollo G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD MH01-01249-416.

5.3 Test Equipment Tolerances

5.3.1 All tolerances specified herein do not include instrumentation uncertainties.

5.4 Test Sequence

5.4.1 The test Sequence normally should follow the steps outlined by Code numbers in Figure I in the order specified. This normal order can be deviated on approval by the G&N Steering Committee.

5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the subassembly in which the malfunction occurred. The chosed subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading or as directed by NASA Test Engineering. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Table I. It must be noted that Table II is to be used only as a guide.

5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Conductor should refer to the pertinent operational manuals.

5.7 The following requirements shall be completed before any of the tests in this specification are attempted.

5.7.1 The G&N System shall have been qualified in accordance with the requirements of the Pre-installation Assembly Test Procedure for the Apollo Guidance and Navigation System (ATP 1026000).

5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in process specification MA0308-0047, Mechanical Installation Specification for Apollo Guidance Equipment (S/C 017).

5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

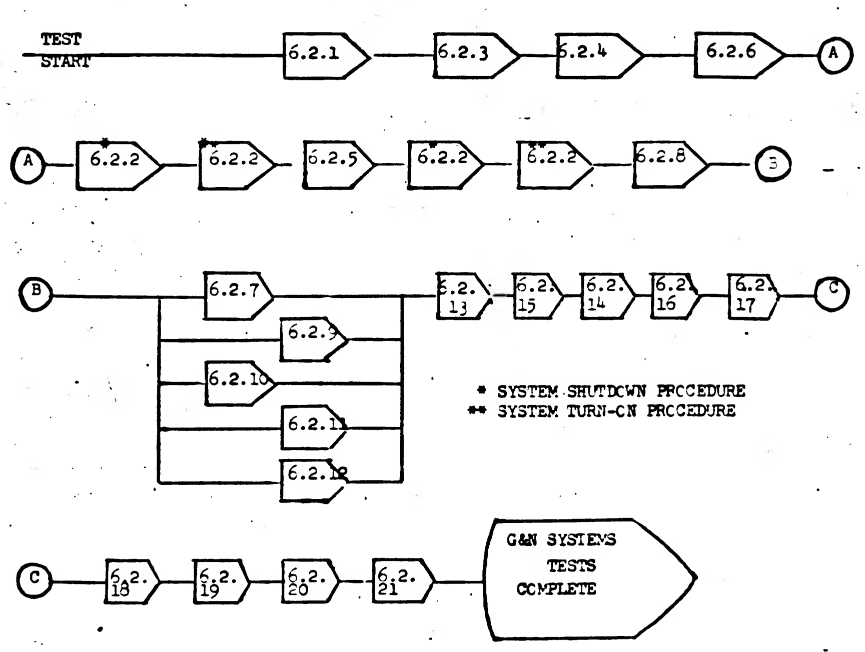
5.8 The following conditions are required for testing the G&N System.

5.8.1 Spacecraft Systems other than the G&N System may be operating on a noninterfering basis while individual system checkout of the G&N System is being conducted.

5.8.2 The G&N System shall be supported by the Electrical Power System and Environment Control System during operation in the Command Module. The Stabilization and Control System shall be connected to the G&N System during G&N operation in the Command Module for passive loading purposes if available.

5.8.3 During tests which interface with the Stabilization and Control System and the Central Timing System, operation of these systems shall be required.

5.9 The G&N System shall be tested per this specification after it is installed in the spacecraft. In the event that the installed system, or any assembly thereof, is removed from the spacecraft for modifications, recycle, or any other reason, this process specification or pertinent portions of it shall be performed after the G&N System, or assembly thereof, is reinstalled. Testing shall be limited to G&N System operation while actively connected to qualified spacecraft threshold systems, namely, the Electrical Power System (EPS), Environmental Control System (ECS), and Communications and Instrumentation System (C&IS) as much as possible. However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS), Central Timing System (CTS) and Caution and Warning System is required for complete G&N System verification.



* SYSTEM SHUTDOWN PROCEDURE
** SYSTEM TURN-ON PROCEDURE

FIGURE 1

G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

TABLE I.
TEST SEQUENCE

PARAGRAPH NO.	TEST TITLE
6.2.1	Application of Standby Power to G&N System
6.2.2	Turn On and Shutdown Procedure
6.2.3	AGC Operational Test
6.2.4	Operate Power On and Power Supply Test
6.2.5	Gimbal Lock Test
6.2.6	G&N Operational Test
6.2.7	IMU Temperature Control Test
6.2.8	AGC Clock Frequency and Alignment Tests
6.2.9	G&N Panel Brightness and Lamp Test
6.2.10	Optics Servo Test
6.2.11	Optics Slew Rate Test
6.2.12	Optics Coordinate Transformation Control Test
6.2.13	Optics Positional Accuracy Test
6.2.15	Gimbal Friction Test
6.2.14	AGC Mode Control Test
6.2.16	Stabilization Loop Step Response Test
6.2.17	IRIG Scale Factor Test
6.2.18	PIPA Scale Factor Determination Test
6.2.19	IRIG Coefficient Determination Test
6.2.20	Fine Alignment Test SXT-NB-IMU
6.2.21	Gyro Compassing Test

TABLE II. RETEST SEQUENCE

Paragraph Number	IMU	OPTICS	AGC	PSA TRAY 1	PSA TRAY 2	PSA TRAY 3	PSA TRAY 4	PSA TRAY 5	PSA TRAY 6	PSA TRAY 7	PSA TRAY 8	PSA TRAY 9	PSA TRAY 10	G&N DSKY	MDC DSKY	D&C ELEC	SIG COND	OCDU'S	ICDU'S	G&N HARNESS
6.2.1	X		X	X	X					X										X
6.2.2			X											X	X					
6.2.4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.2.5																			X	
6.2.3			X			X	X						X	X						X
6.2.9		X												X	X	X				
6.2.7	X		X	X						X						X				
6.2.10		X	X								X	X	X				X	X		
6.2.11		X									X	X	X					X		
6.2.12		X									X	X	X					X		
6.2.13		X									X	X	X					X		
6.2.14	X		X	X	X	X	X	X	X	X						X			X	X
6.2.15	X		X	X	X	X	X	X	X	X					X	X	X		X	X
6.2.16	X		X	X	X					X										
6.2.17	X		X	X	X	X	X		X	X										
6.2.18	X		X	X	X	X	X		X	X										
6.2.19	X		X	X	X	X	X		X	X									X	
6.2.20	X		X	X	X	X	X		X	X										
6.2.21	X	X	X	X	X	X	X		X	X						X	X			
6.2.8			X																	

5.10 The procedure accomplished and the requirements listed herein are verified through the use of Acceptance Checkout Equipment - Spacecraft (ACE-S/C). The Ground Support Equipment (GSE) shall be augmented by the following list of signal conditioning carry-on equipment. This equipment must be connected and ready for operation before the test of this specification is initiated.

a. Carry-on PCM System, Model No. C14-210

b. Digital Signal Conditioner and Multiplexing Unit, Model No. C14-211

c. G&N Signal Conditioner and Switching Matrix, Model No. C14-213

d. Carry-on Receiver and Baseplate, Model No. C14-200

e. Carry-on Baseplate Unit, Model No. C14-201

f. Junction Box ACE-S/C Carry-on, Model No. C14-202

g. Carry-on ACE-S/C Response System Support Rack, Model No. C14-203

h. Support Frame Carry-on DTCS, Model No. C14-204

5.10.1 Ground Support Equipment (GSE) carry-on gear in support of the signal conditioning carry-on gear shall consist of the following:

a. Electrical Cable Set, Model No. C14-178

b. PSA Test Point Adapter, Model No. A23-167

c. Breakout Box - Test C/M-S/M Adapter, Model No. C14-467

d. Volt Ohmmeter Simpson Model No. 269 or equivalent

5.10.2 Ground Support Equipment (GSE) required for performing other selected G&N tests consists of the following:

a. Volt Ohmmeter, Simpson Model No. 269 or equivalent
b. Optics Support Fixture, Model No. A14-135
c. G&N Installation Qualification Fixture, Model No. A23-097.
d. Azimuth Reference Fixture, Model No. A23-096
e. Theodolite (DKM3 or equiv.) Model No. A23-079
f. Retroreflecting Prism 1019840 Model No. A23-200
g. Portable Light Assembly (SCT lamp)

5.10.3 Miscellaneous hardware required in support of G&N testing consists of the following:

a. Movable Optics Target

5.11 Data Record

5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out-of-tolerance readings shall be recorded and flagged by appropriate symbols to attention.

5.11.1.1 Test Data. All test data obtained while demonstrating the requirements of this document shall permanently be recorded and forwarded with the tested G&N to the next receiving agency.

5.11.1.2 An authorized Quality Control Representative shall monitor this test and verify compliance to this specification by signing or stamping applicable documents including all test data recorded. (Form 962-T or equivalent).

5.11.2 The PCM Raw Data magnetic tape recorder shall be turned on at all times while any portion of the G&N is operating.

5.11.3 The Event Recorder, 4A2-A2, shall be turned on at all times while any portion of the G&N System is operating.

5.12 Interface

5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface according to the ICD's listed below.

a.	ICM MH01-01220-216	Interconn Diagram-AGC to AGC DSKY (Main Display Panel)
b.	ICD MH01-01224-416	Attitude Error Signals
c.	ICD MH01-01225-416	Total Attitude Signal
d.	ICD MH01-01226-200	Central Timing Equipment Sync. Pulse
e.	ICD MH01-01227-216	G&N-Electrical Input Power
f.	ICD MH01-01228-416	G&N Data Transmission to Operational PCM-Telemetry Equipment
g.	ICD MH01-01236-200	ACE Uplink, SC Digital Up-Data Link AGC
h.	ICD MH01-01237-216	G&N-Hold Attitude
i.	ICD MH01-01242-416	G&N Condition & Display Lights
j.	ICD MH01-01249-416	G&N-Thermal Requirements
k.	ICD MH01-01248-416	G&N Subsystem Environment

5.13 Optics Power Turn On Procedure for Optical GSE Alignment Test.

5.13.1 The Optical GSE Subsystem Alignment Test must be completed before proceeding with the following tests:

a. 6.2.13 Optic Positional Accuracy Test
b. 6.2.20 Fine Alignment Test
c. 6.2.21 Gyro Compassing Test
d. 6.2.18 PIPA Scale Factor Determination Test

5.13.2 The G&N Optics Turn On procedure for Optical GSE Subsystem Alignment Test may be performed at anytime in the tests in Table I, 6.2.1 through 6.2.9, except for those sequences requiring OPTICS or LIGHTING main power shutdown. Optics power shall only be applied during those tests requiring measurement of optics parameters.

5.13.3 G&N Optics Power Turn-ON

5.13.3.1 Insure that the SXT and SCT eyepieces are installed properly on the G&N Optics base. The optics switches and selectors on the G&N Indicator Control Panel shall be set to the following positions:

a. SLAVE TELESCOPE to STAR LOS
b. OPTICS MODE to ZERO OPTICS
c. CONTROLLER MODE to DIRECT
d. CONTROLLER SPEED to LO
e. POWER and BRIGHTNESS to ON
f. PANEL BRIGHTNESS to maximum increase

5.13.3.2 Place or verify that the LIGHTING AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON position. (Breakers pushed in).

5.13.3.3 Place the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel to ON position. (Breakers pushed in).

5.13.3.4 Verify that the ZERO ENCODER on the Condition Annunciator Panel is lighted for no more than 90 seconds after optics power turn on.

5.13.3.5 OPTICS +28 VDC DISCRETE shall be issued (CG1533) by observing that the OPTICS lamp on the Event Module is lighted.

5.13.3.6 Sight through the SXT eyepiece to verify that the optical reticles are illuminated.

5.13.3.7 Verify that the optics supply voltage listed below appear on the CRT:

a.	CG 1401 OPTX 2V	25.6 KC	Supply in PH	+2.1 to 2.9 VRMS
b.	CG 1211 OPTX 28V	.8 KC	1% DEG supply	+27 to 29 VRMS
c.	CG 1212 OPTX 28V	.8 KC	5%-90 supply	+26.1 to 29.9 VRMS

5.13.3.8 Verify the 2X TRUNNION and SHAFT Angles on the CDU panel display 000.000 ± 0.100 degrees.

5.13.3.9 Ensure that the optics GSE, Optics Support Fixture, Model No. A14-135, has been properly installed.

5.13.3.10 Proceed with the Optical GSE Subsystem Alignment Test in accordance with MA0201-5036.

5.14 There are requirements in 6.2.7 IMU Temperature Control Test, 6.2.18 PIPA Scale Factor Determination Test, and 6.2.19 IRIG Coefficient Determination Test that must be obtained from the Acceptance Data Package. The aforementioned data, which fulfilled the requirements, shall be available prior to checkout of the G&N System.

6. DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis unless otherwise specified. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. S23-100. The temperature of the inertial components shall not drop below 120°F while under control of the ICTC.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and COMPUTER MN B in the ON position and IMU MN A and MN B in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MN A, IMU HTR MN B, COMPUTER MN A, COMPUTER MN B, the Computer Mode Control (CMC) switch to the ON position, and IMU MN A and IMU MN B in the ON position. The G&N System shall be operating in the Standby Mode (with CMC power ON) for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby Mode power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warm-up period shall be mandatory.

6.1.1.2.1 After 6.2.4.5 .3 and 6.2.2.1 have been performed and it is known that the spacecraft or IMU have not been moved, and that the shutdown period did not exceed 5 days, it is permissible to enter the IMU Operate Mode after the system has been in the Standby mode for a minimum of 90 seconds.

6.1.1.3 The Inertial Measurement Unit shall not be without Heater power for a period greater than 15 minutes.

6.1.1.4 During the turn on ~~of~~ the G&N power, the COMPUTER MN A, COMPUTER MN B, IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power, the IMU MN A and IMU B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM.

6.1.1.5 A warm-up period of one hour with OPERATE power applied shall be required prior to performing any test in which gyro or accelerometer parameters are measured, and a 15 minute warm-up period to any test in which precision amplitude and frequency power supply checks are made.

6.1.1.6 The AGC Mode switch shall never be in the STANDBY position when Operate Power is supplied to the G&N System.

6.1.1.7 Remove Operate power if any of the following situations occur as indicated by observing the gimbal resolvers total attitude signals displayed on ACE meters. (CG2112 IGA 1X RES OUTPUT SINE IN PHASE CG 2113 IGA 1X RES OUTPUT COS IN PHASE, CG 2142 MGA 1X RES OUTPUT SINE IN PHASE 2143 MGA 1X RES OUTPUT COS IN PHASE, CG 2172 OGA 1X RES OUTPUT SINE IN PHASE, and CG 2173 OGA 1X RES OUTPUT COS IN PHASE.

a. The gimbals do not stop moving within 15 seconds after first applying operate power while in coarse align.

b. The gimbals do not stop moving within 5-6 seconds after the IMU delay light goes out or when changing from coarse align to fine align attitude control or entry.

c. The gimbals do not stop moving with 5-6 seconds after inserting or removing the step Response Test input.

6.1.2 The UPTL switch on the MDC AGC DSKY Panel No. 14 shall remain in the ACCEPT Position except when otherwise specified as procedural function.

6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

NOTE: Alarm and fail indications may occur in 6.2.1.4.1 while performing this test. Reset alarm by pressing the SYSTEM RESET pushbutton on the ICTC.

6.2.1.1 All power and control switches on the G&N Indicator and Display Panel shall be placed in the OFF or neutral position. Set IMU TEMP mode switch to AUTO OVERRIDE.

6.2.1.2 The Inertial Component Temperature Controller (ICTC) Model No. S23-100, shall be supplying inertial component heater power to the G&N System through Tray No. 7 front panel connector 45A7J2.

6.2.1.3 Computer Power On

6.2.1.3.1 Set the AGC MODE switch to ON position. Switch shall remain in the ON position unless specified otherwise as a procedural step.

6.2.1.3.2 Set G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position (breakers pushed in). Record the value of CG 1520, AGC +28V on the CRT (24.5 V to 30.5 V).

NOTE: Ignore AGC Alarms.

6.2.1.3.3 Set the LIGHTING AC1and AC2 breakers on the Right Hand Circuit Breakers Panel to ON position (breakers pushed in).

6.2.1.3.4 Set the computer numerical display lights to the desired brightness by rotating the BRIGHTNESS thumbwheel on the LEB AGC DSKY and MDC AGC DSKY.

6.2.1.3.5 The AGC +28VDC power discrete shall be issued (CG 1523). This can be observed by the lighted AGC +28 VDC operate lamp on the Event Module.

6.2.1.3.6 Press ERROR RESET pushbutton. Enter VERB 36 in K 148. Press ENTER pushbutton. All computer alarms on the Main Display Console (MDC) and LEB AGC DSKY shall clear.

6.2.1.3.7 The voltage output of the +3 VDC AGC supply shall be +1.88 to +4.12 VDC, CG 1030. The value on CRT shall be recorded.

6.2.1.3.8 The voltage output of the +13 VDC AGC supply shall be +11.7 to 14.3 VDC, CG 1020. The value on CRT shall be recorded.

6.2.1.3.9 Verify that the AGC is in the Backup Mode by monitoring on CRT that the Program indicates 00, and the program readouts on the MDC and LEB AGC DSKY indicate 00.

6.2.1.3.10 Reset MASTER ALARM by pressing the MASTER ALARM LAMP.

6.2.1.3.11 Obtain E Memory Zeroing Tape No. F02C017-K00012-XX and load the tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AGC memory locations.

6.2.1.3.12 Run the remaining portion of tape to initiate AGC Self Test. Wait approximately three minutes.

6.2.1.3.12.1 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT +1 and SCOUNT +2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67 ± 2 seconds. Monitor R1, R2, and R3 until R1 equals 00003, and R2 and R3 equal 00002.

6.2.1.4 Standby Power Temperature Control Loop Tests.

6.2.1.4.1 Enter the IMU Standby Mode of Operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in). Record range time.

6.2.1.4.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted. (CG 1513)

6.2.1.4.3 Set ICTC Power ON-OFF switch to OFF position.

6.2.1.4.4 Record the value of the following signals displayed on CRT:

	Signal	Requirement
a.	CG 1301 2V 3200 CPS POWER SUPPLY	+2.8 to +4.2
b.	CG 1510 + 28 VDC STANDBY POWER	25.8 to 30.8 VDC
c.	CG 1511 +28 VDC STANDBY NOISE	0 to+0.7 VRMS

6.2.1.4.5 The IRIG TEMP and IMU HEATER CURRENT on CRT shall be monitored periodically for one hour to ensure that the IRIG Temperature Control Loop circuitry is operating to maintain a temperature of 128.0°F to 134.0°F and current of 0.75 to 1.60 amperes (when current is applied) (CG 2301) (2302).

6.2.1.4.6 The PIPA TEMP shall be monitored on CRT periodically for one hour to ensure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 128.0°F to 134.0°F (CG 2300). (To be completed concurrently with 6.2.1.4.5).

6.2.1.4.7 The G&N System shall be in the Standby Mode for a minimum of one hour before proceeding with 6.2.1.4.8, Temperature Control Loop Tests. The test of 6.2.3, AGC Operation Test, may be performed during this period.

6.2.1.4.8 Verify that the IMU TEMP MODE switch on the G&N Indicator Control Panel is set to AUTO OVERRIDE Position.

6.2.1.4.9 IRIG Temperature Bridge Calibration Test.

6.2.1.4.9.1 Press and hold ZERO pushbutton on the G&N Indicator Control Panel.

6.2.1.4.9.2 IRIG Temperature Indicating Bridge Amplifier output shall be 132.9°F to 134.1°F (CG 2301). Record indication of IRIG TEMP as displayed on CRT.

6.2.1.4.9.3 Release ZERO pushbutton. The IRIG Temperature Indication Bridge Amplifier output shall be 128.0°F to 134.0°F (CG 2301). Record CRT indication of IRIG Temperature.

6.2.1.4.10 IRIG Temperature Bridge Gain Test.

6.2.1.4.10.1 Press and hold IRIG GAIN pushbutton on G&N Indicator Control Panel. The IMU TEMP condition lamp shall be lighted.

6.2.1.4.10.2 The IRIG Temperature Indicating Bridge Amplifier output shall be 127.9°F to 129.1°F (CG 2301). Record indication of IRIG TEMP as displayed on CRT.

6.2.1.4.11 PIPA Temperature Bridge Calibration Test.

6.2.1.4.11.1 Press and hold ZERO pushbutton on the G&N Indicator Control Panel.

6.2.1.4.11.2 The PIPA Temperature Indicating Bridge Amplifier output shall be 128.9°F to 131.1°F (CG 2300). Record indication of PIPA TEMP as displayed on CRT. Release ZERO pushbutton.

6.2.1.4.12 PIPA Temperature Bridge Gain Test.

6.2.1.4.12.1 Observe Heater Current (CG 2302) on CRT; Press and hold PIPA GAIN pushbutton on G&N Indicator Control Panel. Observe a change in Heater Current on CRT and record CRT indication of PIPA TEMP (CG 2300). Release PIPA GAIN pushbutton.

6.2.1.4.12.2 IMU TEMP condition lamp shall be lighted.

6.2.1.4.12.3 The PIPA Temperature Indicating Bridge Amplifier output shall be 134.4°F to 135.6°F.

6.2.1.4.12.4 Release PIPA GAIN pushbutton, and record indication of PIPA TEMP as displayed on CRT (CG 2300).

6.2.1.4.12.5 IMU TEMP condition shall not be lighted.

6.2.1.4.12.6 The PIPA Temperature Indicating Bridge Amplifier output shall be 128.0°F to 134.0°F.

6.2.1.4.12.7 After a minimum of two hours in the Standby Mode, the following temperatures and current shall be recorded

6.2.1.4.12.7.1 The IRIG Temperature shall be 128.0°F to 134.0°F (CG 2301).

6.2.1.4.12.7.2 The PIPA Temperature shall be 128.0°F to 134.0°F (CG 2300).

6.2.1.4.12.7.3 The Heater current shall be 0.75 to 1.60 amperes (CG 2302).
(only when current is applied).

6.2.2 General Turn Off and Turn ON Procedures

NOTE: This procedure shall be utilized any time after performing 6.2.1, Standby Power On Test, and 6.2.4, Operate Power On Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced on other tests.

6.2.2.1 Turn OFF Procedure

CAUTION

This procedure must be followed in the order specified. Failure to adhere to this procedure may require recalibration of the inertial components.

6.2.2.1.1 Verify or place the TRANSFER switch on the IMU CONTROL Panel to the COMPUTER POSITION.

6.2.2.1.2 Enter the following values into K148 in the listed sequence:

a. Insert VERB 41 NOUN 20 and verify. Press the ENTER pushbutton.
b. Insert +09000 and verify. Press the ENTER pushbutton.
c. Insert +00000 and verify. Press the ENTER pushbutton.
d. Insert -05700 and verify. Press the ENTER pushbutton.

6.2.2.1.3 Verify that the COARSE ALIGN MODE lamp on the IMU CONTROL panel is the only MODE lamp that is lighted. Wait 60 seconds.
NOTE: Ignore PGNS CAUTION Alarm on Condition Annunciator panel.

6.2.2.1.4 Place the TRANSFER Switch on the IMU CONTROL to the MANUAL position.
NOTE: Ignore PROG ALARM and COMP FAIL alarms on LEB and MDC DSKY's. Press ERROR RESET pushbutton.

6.2.2.1.5 Set the following switches on the G&N Indicator Control Panel to the positions designated.

a. SLAVE TELESCOPE to STAR LOS
b. OPTICS MODE to ZERO OPTICS
c. CONTROLLER MODE to DIRECT
d. CONTROLLER SPEED to LO
e. POWER AND BRIGHTNESS to OFF
f. ATTITUDE IMPULSE ENABLE to OFF
g. IMU TEMP MODE to AUTO-OVERRIDE

6.2.2.1.6 Set the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OPEN position (breakers pulled out).

6.2.2.1.7 Set the G&N IMU, MNA and MN B breakers on the Right Hand Circuit Breaker Panel to OPEN position (breakers pulled out).

6.2.2.1.8 The BRIGHTNESS thumbwheel on AGC-DSKY-LEB (lower Equipment Bay) and AGC DSKY-MDC (Main Display Console) shall be decreased to its minimum brightness - OFF position.

6.2.2.1.9 Set the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF position (breakers pulled out).

6.2.2.1.10 Set the G&N LIGHTING AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF position (breakers pulled out).

6.2.2.1.11 Set ICTC POWER ON-OFF switch to ON. Press ALARM RESET switch and verify ALARM RESET lamp is not lighted. Verify that the ICTC is supplying inertial component heater power to the G&N System as indicated by the PTC HEATER POWER lamp illuminated on the PTC. Verify the temperature is within 135 ± 5.0 F and the current is within 1 ± 0.75 amperes on the PTC meter.

6.2.2.2 Turn On Procedures

6.2.2.2.1 Set or verify the following switches on the G&N Indicator Control Panel to the positions designated.

a. SLAVE TELESCOPE to STAR LOS

b. OPTICS MODE to ZERO OPTICS

c. CONTROLLER MODE to DIRECT

d. CONTROLLER SPEED to LO

e. POWER AND BRIGHTNESS to OFF

f. ATTITUDE IMPULSE ENABLE TO OFF

g. IMU TEMP MODE to AUTO OVERRIDE

h. CONDITION LAMPS to ON

6.2.2.2.2 Ensure that SYNC switch on the MDC Panel 25 is in the OFF position.

6.2.2.2.3 Ensure that interfacing systems EPS and ECS are turned on and operating properly.

6.2.2.2.4 Ensure that the TRANSFER switch on the IMU CONTROL panel is set to MANUAL position.

CAUTION

> The remaining procedure must be followed in the order specified. Failure to adhere to this procedure may require recalibration of the inertial components.

6.2.2.2.5 Energize the G&N Lighting AC 1 and AC 2 breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.2.2.6 Ensure that the AGC MODE switch is set to ON position.

6.2.2.2.7 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Ensure that the AGC +28 VDC discrete lamp on Event Module is lighted (CG 1523). Verify that the secondary AGC power supply voltages on the CRT, display the following requirements:

a. CG 1020 +13 VDC AGC Supply +11.7 to +14.3 VDC
b. CG 1030 + 3 VDC AGC Supply +1.88 to +4.12 VDC.

6.2.2.2.8 Disregard all alarm indications on the AGC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton. All computer alarms on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify register R1, R2, and R3 on the AGC DSKY's are cleared.

6.2.2.2.9 Set the computer display lights to minimum usable brightness by rotating the BRIGHTNESS thumbwheels on the LEB AGC DSKY and MDC AGC DSKY.

6.2.2.2.10 Energize the G&N IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).

6.2.2.2.11 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is lighted (CG 1513).

6.2.2.2.12 Reset ICTC alarm if alarm indication is present. Reset ICTC alarm. Verify ICTC ON/OFF switch to ON position.

6.2.2.2.13 Obtain E. Memory Zeroing Tape No. F02C017-K00012-XX and load tape into the tape reader. Run the tape to the first STOP on the tape to zero erasable AGC memory locations.

6.2.2.2.14 Run the remaining portion of Tape No. F02C017-K00012-XX to initiate AGC Self Test. Wait approximately three minutes.

6.2.2.2.14.1 Verify FAILURE DETECT lamp on Event Module 4A3 is not lighted.

6.2.2.2.14.2 Verify G&N ERROR lamp on MDC Panel 10 is not lighted.

6.2.2.2.14.3 R1, R2, and R3 of DSKY will display contents of SCOUNT, SCOUNT +1 and SCOUNT +2 registers, respectively. Verify R1, R2, and R3 are incrementing in a positive direction every 67 ± 2 seconds.

NOTE: If Standby Power (G&N IMU HTR with G&N computer breakers) has been off for two hours or more allow two hours warm up before proceeding. If the G&N System has been off for less than two hours, allow an equal time period for warm up before proceeding.

6.2.2.2.15 After required warmup time has elapsed, set the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker panel to ON position (breakers pushed in). Press the COARS ALIGN pushbutton on the IMU Control Panel. Ensure that the IMU +28 VDC OPERATE (ON) lamp on Event Module is lighted. (CG 1503).
Verify the value of CG 1500, IMU +28 V on the CRT (+24.5 to +30.5 VDC). The gimbal lock lamp on the Condition Annunciator shall be lighted.

6.2.2.2.16 Ensure that the IMU DELAY lamp on the Condition Light Annunciator Panel is lighted and the IMU DELAY lamp on Event Module is lighted (CG 5008).

NOTE: Perform 6.2.2.2.17 only if performance of 6.2.4, 6.2.10, 6.2.11, 6.2.12, 6.2.13, 6.2.20, and 6.2.21 is anticipated.

6.2.2.2.17 Set the G&N OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position (breaker pushed in). Ensure that the OPTX +28 VDC discrete lamp on Event Module is lighted. (CG 1533).

6.2.2.2.18 Verify the value CG 1530, OPTX +28V on the CRT (+25 to 30.8 VDC) *
Verify that the secondary power supply voltages of the following signals as displayed on the CRT is as indicated in Table VI.

* Only if 6.2.2.2.17 is performed.

TABLE VI. SECONDARY POWER SUPPLY VOLTAGES

Meas. No.	Signal	Requirement
a. CG 1000	+120 VDC IRIG Supply	+112.0 to +146 VDC
b. CG 1003	+12 VDC IRIG Supply	+10.6 to +13.4 VDC
c. CG 1006	+32 VDC IRIG Supply	+25.5 to +35.5 VDC
d. CG 1010	+120 VDC PIPA Supply	+107 to +145 VDC
e. CG 1016	+32 VDC PIPA Supply	+25.5 to +35.5 VDC
f. CG 1101	-28 VDC ELECTRONICS	-21.3 to -33.7 VDC
g. CG 1201	IMU 28 V 800 CPS 1% 0°	+27 to +29 VRMS
h. CG 1202	IMU 28V 800 CPS 5%-90°	+26.1 to +29.9 VRMS
i. CG 1203	IMU 28V 800 CPS 5%-0°	+24.7 to +30.3 VRMS
j. CG 1204	CDU 28 800 CPS 5%-90°	+26.1 to +29.9 VRMS
k. CG 1301	IMU 2V 3200 CPS SUPPLY	2.8 to 4.2 VRMS
l. CG 1302	20V 3200 CPS SQ WAVE	+15.6 to +24.4 VRMS
m. CG 1400	IMU 2.5V 25.6 KC in ø	+2.1 to +2.9 VRMS
n. CG 1110	+2.5 VDC T/M REFERENCE	+2.45 to +2.55 VDC
* o. CG 1211	OPTX 28V 800 CPS 1%-0°	+27 to +29 VRMS
* p. CG 1212	OPTX 800 CPS 5%-90°	+26.1 to +29.9 VRMS
* q. CG 1401	OPTX 2.5V 25.6 KC in ø	+2.1 to +2.9 VRMS

6.2.2.2.19 Set the TRANSFER switch on the IMU CONTROL panel to COMPUTER.

6.2.2.2.20 Enter and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton to advance System to COARS ALIGN mode. The VERB-NOUN display on CRT shall flash and indicate 21-22.

* only if 6.2.2.2.17 is performed.

6.2.2.2.21 Enter and verify +00000 into K148 three times pressing the ENTER pushbutton on the K148 after each entry. The COARS ALIGN MODE lamp on the IMU CONTROL panel shall be the only MODE lamp that is lighted. ~~The PGNS CAUTION lamp on the Condition Annunciator may be on.~~

6.2.2.2.22 Monitor the signals listed below on a CRT to ensure that the IMU is not in a Gimbal Lock pondition. The signal shall indicate no gimbal oscillation movement.

	Meas. No.	Signal	Requirement
a.	CG 5003	GIMBAL LOCK WARNING	OFF
b.	CG 2142	MG CDU 1X RES SINE	Not Oscillating
c.	CG 2143	MG CDU 1X RES COSINE	Not Oscillating

6.2.2.2.23 Monitor the signals listed below on the CRT to verify normal PIPA loop operation.

a.	CG 2002	X PIPA SG OUT QUAD	Less than 0.66 VRMS
b.	CG 2022	Y PIPA SG OUT QUAD	Less than 0.66 VRMS
c.	CG 2042	Z PIPA SG OUT QUAD	Less than 0.66 VRMS

6.2.2.2.24 Perform 6.2.6 G&N Operational Test

6.2.3 AGC Operational Test

NOTE: This test shall be performed only when IMU HTR and Computer powers are supplied. Test shall not be performed when IMU operate power is applied.

6.2.3.1 Verify IMU STANDBY power (including AGC operate power) is applied and IMU OPERATE power is not applied, and that AGC MODE switch is ON. (G&N IMU HTR MN A and MN B breakers engaged (breakers pushed in) computer MN A and MN B breakers engaged (breakers pushed in) IMU MN A and MN B breakers disengaged (breakers pulled out).

6.2.3.1.1 Set the TRANSFER switch in MANUAL position on the IMU Control Panel.

6.2.3.1.2 Using LEB AGC DSKY, enter VERB 36. Press ENTER pushbutton. Press ERROR RESET on the LEB DSKY.

6.2.3.2 AGC Interface Checks

6.2.3.2.1 Enter the following sequence into the LEB AGC DSKY to initiate the DSKY test:

a. VERB 57 ENTER

b. 00007 ENTER

6.2.3.2.2 Observe all 9's displayed in the MAJOR MODE, VERB, NOUN and R1, R2 and R3 character positions and that the UPTL lamp is lighted. At approximately 10 second intervals, the following is displayed in the above character positions except where noted.

a. 8's
b. 7's
c. 6's
d. 5's
e. 4's
f. 3's
g. 2's
h. 1's
i. 0's
j. all positions blank
k. MINUS signs in R1 R2 and R3
l. PLUS signs in R1 R2 and R3 with the PROGRAM ALARM, TM FAIL, KEY RELEASE, CHECK FAIL and momentarily COMPUTER ACTIVITY lamps lighted.
m. UPTL lamp not lighted

6.2.3.2.2.1 Press ERROR RESET and KEY RELEASE pushbuttons. The KEY RELEASE and AGC alarm lamps shall not be lighted.

6.2.3.2.3 DSKY Pushbutton Check

6.2.3.2.3.1 Enter VERB 25, NOUN 02 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.2 Enter 01775 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.3 Enter +00123 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.4 Enter -00456 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.5 Enter -00789 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.6 Verify that +00123 is displayed in R1, -00456 is displayed in R2 and -00789 is displayed in R3 in the LEB and MDC AGC DSKY's.

6.2.3.2.3.7 Enter VERB 05, NOUN 02 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.8 Enter 01775 into LEB AGC DSKY. Press ENTER pushbutton.

6.2.3.2.3.9 The LEB and MDC AGC DSKY's shall indicate 00178 in R1, 77067 in R2, and 76352 in R3. Verify the displays.

6.2.3.2.3.10 Repeat 6.2.3.2.3.1 through 6.2.3.2.3.9 using the MDC AGC DSKY.

6.2.3.2.4 C - Relay Check

> **NOTE:** ACCEL FAIL, IMU FAIL, CDU FAIL and ZERO ENCODER lamps on Condition Annunciator panel will light intermittently during this test.

6.2.3.2.4.1 Enter the following sequence into MDC or LEB AGC DSKY to initiate the C-Relay Test:

a. VERB 15 NOUN 01 ENTER
b. 00722 ENTER
c. VERB 57 ENTER
d. 00006 ENTER

6.2.3.2.4.2 Press KEY RELEASE pushbutton after KEY RELEASE lamp lights. Rows R1, R2 and R3 shall display the contents of DSPTAB +11D, (R1), DSPTAB +12D, (R2), DSPTAB +13D, (R3).

6.2.3.2.4.3 The DSPTAB registers will count in the sequence 1, 2, 4, 10, 20, 40, 100, 200, 400, 1000, 2000, beginning with the register in R3, then R2 and finally R1. IN3 will then be displayed. Verify that the above sequence is followed throughout the test and that the final display of R3 is 00001 and IN3 register in R1 shall display one of the following: 0XXXX, 1XXXX, 2XXXX, and 3XXXX.

6.2.3.2.4.4 If an error exists, the PROGRAM ALARM lamp will be lighted and a VERB-NOUN display of 01-33 will flash and R1 on the CRT or DSKY will display 01103 or 41103 for multiple failures. Record.

6.2.3.3 AGC Alarms and Interrupt Test

NOTE: During the following test disregard AGC Alarm indications which are not noted on the test. After each Error Reset for a test sequence insure all alarm lamps are not lighted.

6.2.3.3.1 Obtain G&N Alarms and Interrupts Test Tape No. F02C017-K00020-XX and load the tape on TAPE READER.

6.2.3.3.2 Set the POWER/ON switch on the TAPE READER 4A4-A2 to ON. Perform the following steps on Console 4A4-A3 in sequence:

a. Press the TAPE/KEY indicator to TAPE
b. Press the FWD/REV indicator to FWD
c. Press the IND/CONT indicator to CONT
d. Press the LOAD/INH indicator to LOAD

6.2.3.3.3 Computer Activity

6.2.3.3.3.1 Press the RUN indicator switch on to RUN. Wait until tape stops.

6.2.3.3.3.2 Verify R1 indicates 00001 on CRT.

6.2.3.3.3.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.3.4 Verify that the COMPUTER ACTIVITY lamps on the MDC and LEB DSKY's and Event Module are lighted. The lamps shall remain lighted for approximately 10 seconds (CG 5021).

6.2.3.3.4 RUPT LOCK (Due to extended or infrequent interrupts)

6.2.3.3.4.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.2 Verify R1 indicates 00002 on CRT.

6.2.3.3.4.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.4 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module, and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.

6.2.3.3.4.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.6 Verify R1 indicates00003 on CRT.

6.2.3.3.4.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.4.8 The RUPT LOCK alarm light shall be lighted. Verify indication on LEB DSKY, Event Module and CRT (CG 5028). Disregard all other alarm indications. Press ERROR RESET.

6.2.3.3.5 TC Trap (Due to constant TC instruction or an extended period without a TC instruction being generated)

6.2.3.3.5.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.2 Verify R1 indicates 00004 on CRT.

6.2.3.3.5.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.4 The TC TRAP alarm light shall be lighted. Verify indications on the LEB DSKY and Event Module (CG 5029). Press ERROR RESET pushbuttons.

6.2.3.3.5.5 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.6 Verify R1 indicates 00005 on CRT.

6.2.3.3.5.7 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.5.8 The TC TRAP alarm light shall be lighted. Verify indication on LEB DSKY and Event Module (CG 5029). Press ERROR RESET.

6.2.3.3.6 PGNS CAUTION alarm generated by Nightwatchman program alarm.

6.2.3.3.6.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.6.2 Verify R1 indicates 00006 on CRT.

6.2.3.3.6.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.6.4 Verify the PGNS caution lamp on Condition Annunciator panel and G&N Error lamp on Panel 10 light within 3 seconds after tape stops and that the lamps light for only 2 to 3 seconds. Press Error Reset pushbutton.

6.2.3.3.7 Check Fail and Program Alarm indications.

6.2.3.3.7.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.7.2 Verify R1 indicates 00007 on CRT.

6.2.3.3.7.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until tape stops.

6.2.3.3.7.4 Verify PROG ALARM and CHECK FAIL alarm indications on LEB DSKY and Event Recorder (CG 5020, CG 5023).

6.2.3.3.8 TELEMETRY FAIL ALARM

6.2.3.3.8.1 Press RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.8.2 Verify that R1 displays 00008 on the CRT.

6.2.3.3.8.3 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.8.4 Verify that the TELEMETRY FAIL alarm is illuminated in the MDC and the LEB DSKY.

6.2.3.3.8.5 Verify that SEAL is indicated on the K-START module. Press ERROR RESET to clear AGC DSKY's.

6.2.3.3.8.6 Insert Verb 36 and ENTER into LEB DSKY. Insert VERB 21 NOUN 02 and ENTER into LEB DSKY. Insert 00041 and ENTER into LEB DSKY. Insert 00000 and ENTER into LEB DSKY.

6.2.3.3.9 PARITY FAIL

6.2.3.3.9.1 Press the RUN indicator switch on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.9.2 Verify that R1 indicates 00009 on CRT.

6.2.3.3.9.3 Press the RUN indicator on 4A4-K148 to RUN. Wait until the tape stops.

6.2.3.3.9.4 Verify that PARITY ALARM has been generated and displayed on the MDC and the LEB DSKY's and that the EVENT MODULE is lighted. Disregard all or any other alarm indications. Press ERROR RESET.

6.2.3.4 BANK SUM TEST

6.2.3.4.1 Press ERROR RESET pushbutton and enter VERB 36 into K148, press ENTER pushbutton. Press ERROR RESET pushbutton.

6.2.3.4.2 Enter VERB 56 into K-148, press ENTER pushbutton.

6.2.3.4.3 Verify R1 = R2 = 00002 on CRT.

6.2.3.4.4 Enter VERB 33 into K-148, press ENTER pushbutton.

6.2.3.4.5 Verify R1 = R2 = 000XX on CRT.

6.2.3.4.6 Repeat 6.2.3.4.4 and 6.2.3.4.5 until R1 = R2 = 00034.

6.2.3.4.7 Enter VERB 34 into K-148, press ENTER pushbutton.

6.2.4 Operate Power on and Power Supply Test

CAUTION

a. Insure that the SYNC switch on MDC panel 25 is in the OFF position.

b. The sequence specified in steps 6.2.4.1 through 6.2.4.10.4 must be adhered to. Deviation may necessitate recalibration of inertial components.

6.2.4.1 G&N breakers on the Right Hand Circuit Breaker Panel shall be in the following positions:

a. COMPUTER MN A and MN B breakers ON (Breakers pushed in).
b. IMU HTR MN A and MN B breakers ON (Breakers pushed in).
c. IMU MN A and MN B breakers OFF (Breakers pulled out.)
d. OPTICS MN A and MN B breakers OFF (Breakers pulled out).
e. LIGHTING AC1 and AC2 breakers ON (Breakers pushed in).
f. G&N LIGHTING toggle switch in AC1 (up).

6.2.4.2 The TRANSFER switch on the IMU CONTROL Panel shall be in MANUAL position.

6.2.4.3 The AGC MODE switch on AGC shall be set to ON position.

6.2.4.4 Switches and selectors on the G&N Indicator Control panel shall be set to the following positions:

a. SLAVE TELESCOPE to STAR LOS
b. OPTICS MODE to ZERO OPTICS
c. CONTROLLER MODE to DIRECT
d. CONTROLLER SPEED to LO
e. POWER and BRIGHTNESS to OFF
f. ALTITUDE IMPULSE ENABLE to OFF
g. PANEL BRIGHTNESS to maximum increase
h. IMU TEMP MODE to AUTO OVERRIDE

6.2.4.5 IMU Operate Power

NOTE: Prior to switching to IMU Operate,
the G&N System shall have been in
Standby Mode with AGC power applied,
for a minimum of two hours.

6.2.4.5.1 Set up the Analog Recorder 4A3-A2 and the switches on the Analog Select Panel 4A3-A3 to monitor the following signals:

a.	CG 2206	IGA CDU 1X RES ERR
b.	CG 2236	MGA CDU 1X RES ERR
c.	CG 2266	OGA CDU 1X RES ERR

6.2.4.5.2 Start analog recorder using a chart speed of 5 MM/SEC. Start Event Recorder chart drive using chart speed of 10 MM/SEC. Prepare to mark the strip chart on analog recorder at the time IMU DELAY lamp extinguishes.

6.2.4.5.3 With the IMU in Standby Mode, the IMU Operate Power shall be applied by actuating the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breaker-pushed in). Press COARS ALIGN mode lamp on IMU Control Panel.

6.2.4.5.4 IMU DELAY lamps on the Condition Annunciator Panel, and Event Module shall be lighted when IMU Operate Power is applied (CG 1503). The IMU DELAY lamp shall extinguish after a time delay of 100 ± 10 seconds (CG 5008).

6.2.4.5.5 The COARS ALIGN (Coarse Align), MODE lamp on the IMU CONTROL Panel shall be lighted when IMU Operate power is switched on. After a time delay of 100 ± 10 seconds, the COARS ALIGN lamp shall remain lighted. The gimbal lock lamp on Condition Annunciator panel may be lighted.

6.2.4.5.6 After the IMU DELAY lamps go out, mark the strip chart, stop the Event Recorder, and record the time at which the IMU DELAY lamp is extinguished.

6.2.4.5.7 Stop the Analog Recorder 4A3-A2. Record the time at which the initial transient on OGA CDU 1X Resolver Error signals occurred from Analog Recorder 4A3-A2.

6.2.4.5.8 Determine elapsed time between OGA 1X resolver initial transient and IMU DELAY lamp going out from the recorders.

6.2.4.5.9 Just prior to the time when the IMU DELAY lamp extinguishes, the Outer, Middle, and Inner IMU-CDU 1X Resolver nulls shall be less than 0.600 VRMS (CG 2266, CG 2236, and CG 2206). Record the amplitude of all CDU 1X resolver signals from Analog Recorder 4A3-A2.

6.2.4.5.10 IMU +28 VDC OPERATE discrete shall be issued (CG 1503) by observing that the IMU OPERATE lamp on Event Module is lighted. Record the value of CG 1500, IMU +28V on the CRT (+24.5 to 30.5 VDC).

6.2.4.6 Optics Power On

6.2.4.6.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.4.6.2 OPTICS +28 VDC discrete shall be issued (CG 1533) by observing that the OPTICS lamp on Event Module is lighted. Record the value of CG 1530, OPTX +28V on the CRT (+24.5 to 30.5 VDC).

6.2.4.6.3 Verify that the ZERO ENCODER on the Condition Annunciator Panel is lighted for no more than 90 seconds after Optics Power Turn On.

6.2.4.6.4 The SHAFT ANGLE and TRUNNION ANGLE adjacent to the Scanning Telescope eyepiece shall be 0.0 ± 1.0 degree.

6.2.4.7 Set TRANSFER switch on the IMU CONTROL panel to COMPUTER. Disregard all computer alarms. Enter VERB 36, press ENTER pushbutton, then press ERROR RESET pushbutton. All alarms shall clear.

6.2.4.8 Enter and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton to advance system to COARSE ALIGN under AGC control. The VERB NOUN display on CRT shall flash and indicate 21-22.

6.2.4.9 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton after each entry. The COARSE ALIGN mode lamp on the IMU CONTROL panel shall be the only MODE lamp lighted. Insure that gimbal Lock lamp on Condition Annunciator panel is not lighted.

6.2.4.10 Secondary Power Supply Voltages, Noise Peaks and Phase Difference

NOTE: Ensure that the IMU Operate Power has been on for a minimum of 15 minutes before proceeding with this test.

6.2.4.10.1 Record the secondary power supply voltages of the following signals displayed on the CRT.

Item No.	Measurement No.	Signal	Requirement
a.	CG 1000	+120 VDC IRIG SUPPLY	+112 to +146 VDC
b.	CG 1003	+ 12 VDC IRIG SUPPLY	+10.6 to +13.4 VDC
c.	CG 1006	+ 32 VDC IRIG SUPPLY	+25.5 to +35.5 VDC
d.	CG 1010	+120 VDC PIPA SUPPLY	+107 to +145 VDC
e.	CG 1016	+ 32 VDC PIPA SUPPLY	+25.5 to +35.5 VDC
f.	CG 1020	+ 13 VDC AGC SUPPLY	+11.7 to +14.3 VDC
g.	CG 1030	+ 3 VDC AGC SUPPLY	+1.88 to +4.12 VDC
h.	CG 1101	- 28 VDC SUPPLY	-33.7 to -21.3 VDC
i.	CG 1110	+2.5 VDC TM BIAS	+2.45 to +2.55 VDC
j.	CG 1301	IMU 2V 3200 CPS SUPPLY RMS	2.8 to 4.2 VRMS
k.	CG 1400	IMU 2V 25.6 KC SUPPLY IN PH	+2.1 to +2.9 VRMS
l.	CG 1401	OPTX 2V 25.6 KC SUPPLY IN PH	+2.1 to +2.9 VRMS
m.	CG 1201	IMU 28V .8 KC 1 PCT 0 Deg SUP RMS'	+27 to +29 VRMS
n.	CG 1202	IMU 28V .8KC 5 PCT 90 Deg SUP RMS	+26.1 to +29.9 VRMS
o.	CG 1203	IMU 28V .8 KC 5 PCT 0 Deg SUP R MS	+24.7 to +30.3 VRMS
p.	CG 1204	CDU 28V .8 KC PCT 90 Deg SUP RMS	+26.1 to +29.9 VRMS
q.	CG 1211	OPTX 28V .8 KC 1 PCT 0 Deg SUP RMS	+27 to 29 VRMS
r.	CG 1212	OPTX 28V .8 KC 5 PCT -90 Deg SUP RMS	+26.1 to +29.9 VRMS
s.	CG 1302	20V 3.2 KC SQ WAVE SUPPLY RMS	+15.6 to +24.4 VRMS

6.2.4.10.2 **Record the noise peaks of the following signals displayed on the CRT:**

Item No.	Meas'mt No.	Signal	Requirement
a.	CG 1001	+120 VDC IRIG NOISE RMS	Less than ±1.00VRMS
b.	CG 1011	+120 VDC PIPA NOISE RMS	Less than ± 1.0 VRMS
c.	CG 1021	+ 13 VDC AGC NOISE RMS	Less than 0.65 VRMS
d.	CG 1031	+ 3 VDC AGC NOISE RMS	Less than 0.65 VRMS
e.	CG 1501	+ 28 VDC No. 1 NOISE RMS	Less than ± 0.70 VRMS
f.	CG 1511	+ 28 VDC No. 2 NOISE RMS	Less than ± 0.70 VRMS
g.	CG 1521	+ 28 VDC No. 3 NOISE RMS	Less than ± 0.70 VRMS
h.	CG 1531	+ 28 VDC No. 4 NOISE RMS	Less than ± 0.70 VRMS

6.2.4.10.3 **Record the phase difference of the following signals displayed on the CRT:**

a.	CG 1206	PH DIF IMU 1% 0°, IMU 5% 90°	-77.0 to -103°
b.	CG 1207	PH DIF IMU 5% 0°, IMU 5% 90°	-77.0 to -103°
c.	CG 1306	PH DIF IMU 2V 3.2KC AGC SYNC	-12.5 to +12.5°
d.	CG 1209	PH DIF IMU 1% 0° CDU 5% 90°	-77 to -103
e.	CG 1220	PH DIF IMU 1% 0° OPTX 1% 0°	-12.5 to +12.5°
f.	CG 1402	PH DIF IMU 25.6KC OPTX 25.6KC	-32 to +32°
g.	CG 1216	PH DIF OPTX 1% 0° OPTX 5% 90°	-77 to -103°

6.2.4.10.4 **The noise peaks of the following signals are demonstrated on the event lights when the peak voltage exceeds 5 volts and is present for more than one microsecond.**

			Event Module
a.	CG 1022	+13 VDC AGC NOISE PEAK	4A3-A5
b.	CG 1032	+ 3 VDC AGC NOISE PEAK	4A3-A5
c.	CG 1502	+28 VDC No. 1 NOISE PEAK	4A3-A5
d.	CG 1512	+28 VDC No. 2 NOISE PEAK	4A3-A5
e.	CG 1522	+28 VDC No. 3 NOISE PEAK	4A3-A5
f.	CG 1532	+28 VDC No. 4 NOISE PEAK	4A3-A5

6.2.4.10.5 **Perform 6.2.6 G&N Operational Test.**

6.2.4.10.6 Optics power shall be removed by actuating the G&N OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel to off. (breakers pulled out).

6.2.5 **GIMBAL LOCK TEST**

6.2.5.1 Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn on Procedure.

6.2.5.2 Insert and verify VERB 41, NOUN 20 into K148. Press ENTER pushbutton.

6.2.5.3 Insert and verify +00000 into K148 two times, pressing ENTER pushbutton after each insertion.

6.2.5.4 Insert and verify +05400 into K148. Press ENTER pushbutton. Wait 60 seconds.

6.2.5.5 Verify that GIMBAL LOCK lamp on Condition Annunciator panel is not lighted.

6.2.5.6 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.

6.2.5.7 Insert and verify +06500 into K148. Press ENTER pushbutton. Wait 60 seconds.

6.2.5.8 Verify that GIMBAL LOCK lamp on Condition Annunciator panel is lighted.

6.2.5.9 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.

6.2.5.10 Insert and verify +18000 into K148. Press ENTER pushbutton and observe that GIMBAL LOCK lamp remains lighted while IMU and CDU are driving to 180 degrees. Wait 60 seconds.

6.2.5.11 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.

6.2.5.12 Insert and verify +29500 into K148. Press ENTER pushbutton and observe that GIMBAL LOCK lamp remains lighted while IMU and CDU are driving to 295 degrees. Wait 60 seconds.

6.2.5.13 Insert and verify VERB 23, NOUN 22 into K148. Press ENTER pushbutton.

6.2.5.14 Insert and verify +30600 into K148. Press ENTER pushbutton.

6.2.5.15 Verify that the GIMBAL LOCK lamp on Condition Annunciator panel is not lighted.

6.2.6 G&N Operational Test

Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.6.1 Initial Conditions

6.2.6.1.1 Ensure that the AGC MODE switch is in the ON position.

6.2.6.1.2 Verify that TRANSFER switch on IMU CONTROL Panel is in COMPUTER position and that the AGC Mode switch is in the ON position.

6.2.6.2 Initiation

6.2.6.2.1 Insert the following sequence into K148.

a) VERB 57 ENTER
b) 00004 ENTER

6.2.6.2.2 Verify that the PROGRAM display on CRT indicates 07.

NOTE: During this portion of the test, the G&N System is exercised through its modes and the MODE lamp displays will change automatically in the following sequence: ZERO ENCODE, FINE ALIGN, ATTITUDE CONTROL, COARSE ALIGN and FINE ALIGN. If the PROGRAM display on the LEB DSKY does not change, proper mode changing is occurring.

6.2.6.2.3 After approximately 10 minutes, the value of the gravity vector in CM/SEC^2 shall be displayed in R1 and R2 on CRT. Record these values. Verify VERB 06, NOUN 66 are flashing near end of 10 minute period.

6.2.6.2.4 R1 is the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be +980.00000 ± 10.00000 CM/SEC^2.

6.2.6.2.5 Enter VERB 33 into K148. Press the ENTER pushbutton. Verify that VERB 06 and NOUN 66 are flashing.

6.2.6.2.6 The value of the horizontal earth rate shall be displayed in R1 and R2 on CRT. Record these values.

6.2.6.2.7 R1 is the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between R1 and R2. The horizontal earth rate shall be 00000.82980 to 00000.87864 ERU (Earth Rate Unit).

6.2.6.3 Test Termination

6.2.6.3.1 Enter VERB 34 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.6.3.3 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.4 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.5 Enter 00000 into K148. Press the ENTER pushbutton.

6.2.6.3.6 Verify COARSE ALIGN is the only Mode lamp lighted.

6.2.7 IMU Temperature Control Test

6.2.7.1 Proceed with this test if test in 6.2.4, Operate Power On Test, has been completed and system operation has not been interruped. If system operation has been interruped, perform 6.2.2.2 before proceeding. The signal values of this test are to be recorded as displayed on the CRT. The following Measurement Numbers and Signals are inserted here as a convenience for later reference.

ITEM NO.	MEASUREMENT NO.	SIGNAL
a.	CG 2300	PIPA TEMP
b.	CG 2301	IRIG TEMP
c.	CG 2302	HEATER CURRENT
d.	CG 2303	BLOWER CURRENT
e.	CG 2304	T.C. BRIDGE SUPPLY

6.2.7.1.1 Insure that the following Ground Support Equipment (GSE), identified in 4.1, is installed and connected before proceeding with 6.2.7.2

a. Digital Signal Conditioning and Multiplexing Unit,
Model No. C14-211.

b. G&N Signal Conditioning and Switching Matrix Unit (DTMG)
Item 7.

c. Carry-On Command Stimuli Unit (ACE-S/C Digital Test
Command System DTCS) Item 1.

d. ACE-SC Carry-On Junction Box
Item 3.

e. PSA Adapter Module
Item 17.

f. External Digital Test Command Unit
Item 9.

g. Data Interleaver System
Item 10.

h. Electrical Cable Set
Item 13.

6.2.7.2 Set the TRANSFER switch on the IMU CONTROL panel to MANUAL. Reset any AGC alarms by entering VERB 36, pressing ENTER pushbutton then pressing ERROR RESET pushbutton on LEB AGC DSKY.

6.2.7.3 Place the G&N IMU to Standby Mode by positioning the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (Breakers pulled out). Note that the IMU OPERATE discrete lamp on Event Module is not lighted.

6.2.7.4 Place the IMU TEMP MODE selector on the G&N Indicator Control Panel to AUTO OVERRIDE position.

6.2.7.5 With the IMU in the Standby Mode, wait 30 minutes and record the values of the following signals as displayed on CRT. The BLOWER CURRENT will not be on at this time (CG 2303).

Measurement No.	Signal	Requirements
a. CG 2300	PIPA TEMP	128.0°F to 134.5°F
b. CG 2301	IRIG TEMP	128.0°F to 134.5°F
c. CG 2302	HEATER CURRENT	0.75 to 1.60 AMP
d. CG 2304	T.C. BRIDGE SUPPLY	18.4 to 25.5 VDC

6.2.7.6 Place the G&N IMU to Operate Mode by setting the G&N IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to ON position. After the IMU DELAY lamp goes out, press the COARS ALIGN pushbutton on the IMU CONTROL panel. The COARS ALIGN lamp is the only MODE lmap that is lighted. Record the time when IMU Operate power is applied.

6.2.7.7 Place the TRANSFER switch on the IMU control panel to COMPUTER.

6.2.7.8 Enter VERB 40, NOUN 20 into K148. Press ENTER pushbutton. Wait 90 seconds.

6.2.7.9 Enter VERB 41, NOUN 20 into K148. Press ENTER pushbutton.

6.2.7.10 Enter +00000 into K148 three times, pressing ENTER pushbutton after each entry. COARS ALIGN mode lamp on the IMU CONTROL panel shall be the only MODE lamp lighted.

6.2.7.11 Proportional Mode

6.2.7.11.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to PROPORTIONAL position.

6.2.7.11.2 Thirty minutes after IMU Operate Mode, the signal values of 6.2.7.1 shall be as follows:

a. The PIPA temperature shall be 129.0° to 131.0°F and the IRIG temperature shall be 133.0 to 136.0°F (CG 2300, CG 2301).

b. The Heater current shall be 0.55 to 1.41 amperes (when current is applied) (CG 2302).

c. The Blower current shall be 0.15 to 0.55 amperes (when current is applied) (CG 2303).

d. The Temperature Control Bridge supply shall be 18.4 to 25.4 VDC (CG 2304).

6.2.7.11.3 After two hours from time IMU MN A and MN B power was applied, the following values shall be present.

a. The PIPA Temperature shall be 129.5 to 131.0°F and the IRIG temperature shall be 133.0 to 136.0°F (CG 2300, CG 2301).

b. The Heater current shall be 0.55 to 1.41 amperes (when current is applied) (CG 2302).

c. The Blower current shall be 0.15 to 0.55 amperes (when current is applied)(CG 2303).

6.2.7.11.4 Set IMU TEMP MODE selector to AUTO OVERRIDE. Monitor at 5-minute intervals the values of signals a and b in 6.2.7.1 for 15 minutes (3 monitor periods). Record the maximum values of each signal during this time. These values shall be within those requirements listed in 6.2.7.11.3.

6.2.7.12 Backup Mode

6.2.7.12.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to BACKUP position. The IMU TEMP lamp on Condition Annunciator Panel will cycle on and off.

after 60 minutes:

a. The PIPA temperature shall be 129.5 to 133.0°F.
b. The IRIG temperature shall be 134.5 to 137.5°F.

6.2.7.12.2 Monitor at 5 minute intervals, the values of signals a and b in 6.2.7.1. At the end of 15 minutes (3 monitor periods) record the maximum and minimum values of these signals. The values shall be within those requirements listed in 6.2.7.12.1.

6.2.7.13 Emergency Mode

6.2.7.13.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to EMERGENCY position. The IMU TEMP lamp on the condition annunciator panel will be on during EMERGENCY MODE.

6.2.7.13.2 After the IMU has been switched to EMERGENCY control for a minimum of one hour, the IRIG temperature shall remain within ± 2.0F of its value in 6.2.7.11.3 and PIPA temperature shall remain within ± 2.0 F of its value in 6.2.7.11.4 as indicated on the CRT.

6.2.7.14 Auto Override Mode

6.2.7.14.1 Set the IMU TEMP MODE selector on the G&N Indicator Control Panel to AUTO OVERRIDE position. Wait 30 minutes. The signal values shall be as follows: Record the values.

a. The PIPA Temperature shall be within 129.0 to 131.0°F and the IRIG temperature shall be within 133.0 to 136.0°F (CG 2300, CG 2301).

6.2.8 AGC Clock Frequency and Alignment Tests

6.2.8.1 Perform this test if 6.2.4, Operate Power On Test or 6.2.2.2, Power On Procedure has been completed and G&N System Operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Power On Procedure before proceeding.

6.2.8.2 Ensure that the AGC has been operating for at least 10 minutes before this test.

6.2.8.3 Ensure that the 5245L ELECTRONICS power has been applied for the length of time as required by the manufacturers' specifications.

6.2.8.4 Verify that the coax PIPA FREQ MON is connected between Signal Test Point and the AC Signal Input of 5245L ELECTRONIC COUNTER.

6.2.8.5 Set the switches on the 52452 ELECTRONIC COUNTER to the following positions:

6.2.8.5.1 Set the Preset Counter to indicate 96000.

6.2.8.5.2 Set TIME BASE to ms

6.2.8.5.3 Set FUNCTION to TIME INTERVAL

6.2.8.5.4 Set MODE to NX PERIOD

6.2.8.5.5 Set SENSITIVITY to 1

6.2.8.6 Rotate the ACCEL MON selector switch on the PSA Adapter Module to ACE position.

6.2.8.7 Enter the code 1000 into R-START 4A4-A5-R147. The upper portion of the indicator shall be illuminated. Press the XEQ/SEAL pushbutton to switch the IMU 3.2 KCpower supply on to the hardline. Voltage shall be available on the vertical input to the PIPA Scope 4A4-A1.

6.2.8.8 Each count cycle should last approximately 30 seconds. Adjust display time to permit recording the display on the E-PUT.

6.2.8.9 Repeat the counting cycle 10 times and record the results of the 10 counting cycles. Calculate the average time per cycle for the 10 counting cycles. Record the average time per cycle.

6.2.8.10 The average time shall be not greater than

$$\frac{96000}{3199.9922} = 30.0000731 \text{ seconds, nor less than}$$

$$\frac{96000}{3200.0078} = 29.9999269 \text{ seconds}$$

6.2.8.11 **AGC Clock Alignment Test**

6.2.8.11.1 Ensure that ACE Uplink Alternate Load 2 is loaded in ACE computer.

6.2.8.11.2 Ensure that the UPTEL switch on MDC DSKY is in ACCEPT position and that CRT indicates

ACCEPT UPLINK - ON
CHECK FAIL - OFF
T/M FAIL - OFF

6.2.8.11.3 Ensure that TM FAIL and CHECK FAIL indications on DSKY are off.

6.2.8.11.4 Set R144 to 0001 and execute, observe that CRT indicates TIME ERROR as blank.

6.2.8.11.5 Set 7000035020 into C156 to insert K-FACT. Execute.

6.2.8.11.6 Set 7100000000 into C156 to insert TEPOCH. Execute.

6.2.8.11.7 Obtain Range Time in Hrs, Mins, Secs, (2 times).

6.2.8.11.8 Add 5 minutes to Range Time and insert 90 XX (HRS) XX (MIN'S) XXX (SEC's) into C156. Execute.

6.2.8.11.9 Set 91 + 0000000 into C156 to insert AGC RESET time. Execute.

6.2.8.11.10 Before Range Time +5 minutes occurs, set 0001 into R152 and execute.

6.2.8.11.11 Verify that CRT indication of TIME ERROR is blank.

NOTE: If TIME ERROR 1 is present, repeat all preceding steps of AGC Clock Alignment.

6.2.8.11.12 Set R152 to 0000 and execute.

6.2.8.11.13 Set R152 to 0010 and execute. Record CRT indication of DELTA TIME. Verify that CRT indication of TIME ERROR is blank.

6.2.8.11.14 Set R152 to 0000 and execute.

6.2.8.11.15 Set R152 to 0100 and execute. Verify that CRT indication of TIME ERROR is blank.

6.2.8.11.16 Set R152 to 0000 and execute.

6.2.8.11.17 Set R152 to 0010 and execute. Record CRT indication of DELTA TIME. DELTA TIME shall be 000 HRS 00 MIN 000.000 SEC ± 0.01 sec.

6.2.8.11.18 Set R152 to 0000 and execute.

6.2.9 G&N Panel Brightness and Lamp Test

6.2.9.1 Panel Brightness Control Operation - the PANEL BRIGHTNESS thumbwheel shall be exercised to demonstrate the capability of controlling the illumination of the following lamps:

a. Optical Reticles

b. Telescope Angle Readouts

c. IMU-CDU Differance Display

d. COARS ALIGN MODE lamp on IMU CONTROL Panel

e. CDU Displays

6.2.9.2 Mode Indication Lamp Check - The CHECK MODE lamps pushbutton shall be depressed and cause the following MODE lamps to be illuminated:

a. ZERO ENC

b. COARS ALIGN

c. FINE ALIGN

d. CDU MAN

e. ATT CONT

f. ENTRY

g. TRACKER

6.2.9.2.1 Release the CHECK MODE lamps pushbutton. All MODE lamps except COARS ALIGN lamp on the IMU CONTROL Panel shall be extinguished.

6.2.9.3 Condition indication Lamp Check. - Set CONDITION LAMP switch ON/OFF to ON position. The CHECK CONDITION lamps pushbutton shall be depressed and shall cause the following lamps to be illuminated:

a. PGNS CAUTION

b. AGC PWR FAIL

c. IMU FAIL

e. ACCEL FAIL

NUMBER	REVISION LETTER	PAGE

- f. G&N FAIL
- g. GIMBAL LOCK
- h. IMU TEMP
- i. ZERO ENCODER
- j. IMU DELAY (This lamp will not illuminate in Systems Standby mode)
- k. MASTER ALARM

6.2.9.3.1 Release CHECK CONDITION lamps pushbutton. All condition lamps on the Condition Annunciator Panel shall be extinguished.

6.2.9.4 AGC Display Indication - On depression of Test Alarm Switch, the proper operation of the AGC alarm circuitry will be demonstrated by the illumination of the following lamps:

- a. RUPT LOCK
- b. TC TRAP
- c. COUNTER FAIL
- d. PARITY FAIL
- e. PGMS

6.2.9.4.1 Press ERROR RESET pushbutton. All alarm lamps on the AGC DSKY shall be extinguished. The IMU DELAY lamp lights for 100 seconds when system is in Operate mode.

6.2.9.5 Check Coolant - The CHECK COOLANT pushbutton shall be depressed and shall cause illumination of the area in which the coolant quick disconnects are contained. Verify that the quick disconnects are not leaking and the metallic areas of the quick disconnects, visible through the Port Holes, have no droplets of condensation that might drip.

6.2.9.5.1 Release CHECK COOLANT lamp pushbutton. The COOLANT lamp shall not be lighted.

6.2.10 Optics Servo Tests

6.2.10.1 Proceed with this test if 6.2.4, Operate Power-On Test, has been completed, and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2., Turn-On Procedure, before proceeding.

6.2.10.2 Ensure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker panel are pushed in. Insure that the TRANSFER switch on the IMU Control Panel is set to COMPUTER.

6.2.10.3 Ensure that the SLAVE TELESCOPE switch on the G&N Indicator Control Panel is set to STAR LOS, the TRACKER POWER switch is set to OFF and the TRACK pushbutton is not illuminated. Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

NOTE: If the G&N System is in IMU Operate Mode, ensure that the system is in Coarse Align Mode under AGC control.

6.2.10.4 Trunnion CDU Servo Loop Check

6.2.10.4.1 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to MED and the CONTROLLER MODE switch to DIRECT.

6.2.10.4.2 Enter the code 2019000000 into the C-START module. Press the XEQ/SEAL pushbutton to call CG 3206 TRUNNION CDU TACH OUTPUT to the high rate channel of the Analog Recorder 4A1-A03.

6.2.10.4.3 Set up to monitor the following signals on the Analog Recorder 4A3-A02:

CG 3104 SXT TRUN MDA INPUT INPHASE
CG 3114 SXT SHAFT MDA INPUT INPHASE

6.2.10.4.4 Start the Analog Recorders at 5 mm/sec. Move and hold the OPTICS CONTROL STICK to its upper limit not longer than 10 sec. Release the control stick and stop the Analog Recorders. Record the maximum values of CG 3206, TRUNNION CDU TACH OUTPUT and CG3104, SXT TRUN MDA INPUT INPHASE.

6.2.10.4.5 The maximum value of CG 3206, TRUNNION CDU TACH OUTPUT, shall be 1.05 ± 0.20 VRMS. The maximum value of CG 3104, SXT TRUN MDA INPUT INPHASE, shall be 1.25 ± 0.20 VRMS.

6.2.10.4.6 Set the CONTROLLER SPEED selector to LO.

6.2.10.4.7 Set the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER has extinguished, return the selector to MANUAL.

6.2.10.4.8 Repeat 6.2.10.4.4 . The maximum value of CG 3206, TRUNNION CDU TACH OUTPUT, shall be 0.105 ± 0.020 VRMS. The maximum value of CG 3104, SXT SHAFT MDA INPUT INPHASE, shall be 0.125 ± 0.021 VRMS.

6.2.10.5 Shaft CDU Servo Loop Check

6.2.10.5.1 Enter the code 2020000000 into the C-START module. Press the XEQ/SEAL pushbutton to call CG 3226, SHAFT CDU TACH OUTPUT, to the high rate channel of Analog Recorder 4A1-A03.

6.2.10.5.2 Set the CONTROLLER SPEED selector on the G&N Indicator Control Panel to MED.

6.2.10.5.3 Place the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER has extinguished, place the selector to MANUAL.

6.2.10.5.4 Start the Analog Recorders 4A1-A03 and 4A3-A02 at 5 mm/sec. Move and hold the OPTICS CONTROL STICK against its right limit for not longer than 10 sec. Release the control stick and stop the Analog Recorders. Record the maximum values of CG 3226, SHAFT CDU TACH OUTPUT and CG 3114, SXT SHAFT MDA INPUT INPHASE.

6.2.10.5.5 The maximum value of CG 3226, SHAFT CDU TACH OUTPUT, shall be 1.05 ± 0.20 VRMS. The maximum value of CG 3114, SXT SHAFT MDA INPUT INPHASE, shall be 1.25 ± 0.20 VRMS.

6.2.10.5.6 Set the CONTROLLER SPEED selector to LO.

6.2.10.5.7 Repeat 6.2.10.5.3 and 6.2.10.5.4. The maximum value of CG 3226, SHAFT CDU TACHOUTPUT shall be 0.105 + 0.020 VRMS. The maximum value of CG 3114, SXT SHAFT MDA INPUT INPHASE shall be 0.125 ± 0.021 VRMS.

6.2.10.6 Optics Time to Zero

6.2.10.6.1 Set selector on G&N Indicator Control Panel to ZERO OPTICS. Wait 90 sec. Set selector on G&N Indicator Control Panel to MANUAL.

6.2.10.6.2 Set up the Analog Recorder to monitor the following signals at a chart speed of 10 mm/sec. Do not start recorder at this time.

		Analog Recorder
a.	CG 3226, SHAFT CDU TACH OUTPUT	4A3-A2-1-2
b.	CG 3206, TRUNNION CDU TACH OUTPUT	4A3-A2-2-2
c.	CG 3124, SCT SHAFT TACH FEEDBACK	4A3-A2-5-2
d.	CG 3134, SCT TRUNNION TACH FEEDBACK	4A3-A2-6-2

6.2.10.6.3 Using the control stick, drive the 2X Trunnion CDU in a positive direction to 120.0XX degrees and the Shaft CDU to 270.0XX degrees.

6.2.10.6.4 Start the Analog Recorder and set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS.

6.2.10.6.5 When all signals have reached a steady state value, set the attenuation on the Analog Recorder to the lowest usable ranges.

6.2.10.6.6 After 5 seconds, stop the recorder. Record the elapsed time between steady state nulls on all signals listed in 6.2.10.6.2. The elapsed time between steady state nulls shall be less than 27 sec. for signals a) and c) and less than 12 sec. for signals b) and d).

6.2.10.6.7 Record the level of the CG 3141 TRUNNION CDU 16X RESOLVER and CG 3211, SHAFT CDU 16X RESOLVER signals on the CRT. The absolute value of these signals shall be 0.005 VRMS.

6.2.10.6.8 Record the SHAFT and 2X TRUNNION CDU indications. The 2X TRUNNION and SHAFT angle readouts shall be 0.000 ± 0.006 degrees.

6.2.10.7 AGC Mode Indication and Control

6.2.10.7.1 Enter and verify VERB 16 and NOUN 55 into K148. Press the ENTER pushbutton. The AGC display R1 and R2 on the CRT shall be all zeros.

6.2.10.7.2 Enter and verify VERB 11 (MONITOR) and NOUN 01 (ADDRESS) into K148. Press the ENTER pusbbutton.

6.2.10.7.3 Enter address 00007 into K148. Press the ENTER pushbutton. The AGC display on the CRT shall indicate the contents of IN3 in R1 to be X4XXX.

6.2.10.7.4 Set the OTPICS MODE selector on the G&N Indicator Control Panel to MANUAL. The AGC display on the CRT shall indicate contents of IN3 in R1 to be X0XXX.

6.2.10.7.5 Set the OPTICS MODE selector on the G&N Indicator Control Panel to COMPUTER. The AGC display of Mode Register IM3 in R1 shall indicate 3XXXX or 7XXXXX on CRT.

6.2.10.7.6 Enter the following sequence into the K148 and verify:

a. VERB 21, NOUN 01 ENTER
b. 00723, ENTER
c. 40000, ENTER
d. VERB 41, NOUN 55, ENTER
e. +03000, ENTER
f. +15000, ENTER

6.2.10.7.7 Verify that the SHAFT and the 2X TRUNNION CDU move to 30.0 degrees.

6.2.10.7.8 Enter the following sequence into the K148:

a. VERB 21, NOUN 01, ENTER
b. 00723 ENTER
c. 40001 ENTER

6.2.10.7.9 Verify that the SHAFT and 2X TRUNNION CDU readouts move to 0.000 ± 0.006 degrees and stop.

6.2.10.7.10 Enter and verify VERB 16, NOUN 55 into K148. Press ENTER pushbutton. The AGC display of Registers R1 and R2 on the CRT shall be all zeros.

6.2.10.7.11 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return selector to MANUAL.

6.2.11 Optics Slew Rate Test

6.2.11.1 Proceed with this test if 6.2.4, Operate Power-On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2, Turn-On Procedure, before proceeding.

6.2.11.2 Insure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breakers panel are pushed in. Insure that the TRANSFER switch on the IMU Control Panel is set to COMPUTER, and that the OPTICS MODE switch is set to DIRECT position.

6 2.11.3 Verify that the G&N System is in the Coarse Align Mode under AGC control. COARSE ALIGN MODE lamp is the only MODE lamp that is lighted.

6.2.11.4 Slew Rate - High Speed

6.2.11.4.1 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to HI.

6.2.11.4.2 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.4.3 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 00.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.4.4 before proceeding. Do not hold control stick at upper limit for more than ten seconds. Clear any indications on DSKY with "ERROR RESET" or "KEY RELEASE".

6.2.11.4.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately five seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick. Verify KEY RLSE is lighted add press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2, and R3, In a few seconds (approximately 10 seconds), the displays in R1, R2, and R3 change; record the second displays in R1, R2 and R3.

NOTE: The R1, R2, and R3 displays when the "MARK" pushbutton is pressed are as follows:
R1 is Shaft Angle as 000.00 ± 000.10 degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

NOTE: If R1 is not within ± .10 repeat 5.2.11.4.4

6.2.11.4.5 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.4.4 as Δ Trun, and Δ Time.

6.2.11.4.6 Compute and record the Trunnion slew rate as the ratio degree/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.4.7 The Trunnion slew rate shall be 9.0 ± 1.8 degrees/second.

6.2.11.4.8 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished, return selector to MANUAL position.

6.2.11.4.9 Record the SHAFT CDU and 2x TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.4.10 before proceeding. Do not hold control stick at right limit for more than ten seconds.

6.2.11.4.10 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately five seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2, and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

NOTE: The R1, R2, and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

NOTE: If R2 is not within 00.000 ± .100 repeat 6.2.11.4.10.

6.2.11.4.11 Compute the respective differences between the R1 and R3 displays recorded in 6.2.11.4.10 as ΔShaft and Δ Time.

6.2.11.4.12 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.4.13 The Shaft slew rate shall be 17.0 ± 3.4 degrees/second.

6.2.11.5 Slew Rate - Medium Speed

6.2.11.5.1 Set up Analog Recorders to measure the following signals at the location specified:

a.	CG 3141	TRUN CDU 16X RES ERROR	4A1-A3-7-0
b.	CG 3120	SXT TRUN 1X RES ERROR	4A1-A2-8-0
c.	CG 3130	SCT SHAFT 1/2X RES ERROR	4A3-A2-2-3
d.	CG 3211	SHAFT CDU 16X RES ERROR	4A3-A2-8-2

6.2.11.5.2 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to MED.

6.2.11.5.3 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lqmp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.5.4 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.5.5 before proceeding. Do not hold control stick at upper limit for more than twanty seconds.

6.2.11.5.5 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.6 Record the value of signals specified in 6.2.11.5.1.

CG 3120 SCT TRUN 1X RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2, and R3 displays when the "MARK" pushubtton is pressed are as follows:
R1 is Shaft Angle as 000.00 ± 000.10 degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is time as xxx.xx seconds

NOTE: If R1 is not within ± .10 repeat 6.2.12.5.5.

11.5.5

6.2.11.5.7 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.5.5 as Δ Trun, and Δ Time.

6.2.11.5.8 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.5.9 The Trunnion slew rate shall be 1.0 ± 0.2 degrees/seconds

6.2.11.5.10 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished, return selector to MANUAL position.

6.2.11.5.11 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be k000.00 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.5.12 before proceeding. Do not hold control stick at right limit for more than ten seconds.

6.2.11.5.12 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RELEASE is displayed, press KEY RELEASE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.5.13 Record the value of signal c specified in 6.2.11.5.1.

c) CG 3130 SCT SHAFT 1X RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2 and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R2 is not within 00.000 ± .100, repeat 6.2.11.5.12.

6.2.11.5.14 Compute the respective differences between the R1, and R3 displays recorded in 6.2.11.5.12 as ∆ Shaft, and ∆ Time.

6.2.11.5.15 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \ \text{Shaft}}{\Delta \ \text{Time}}$$

6.2.11.5.16 The Shaft slew rate shall be 2.0 ± 0.2 degrees/second.

6.2.11.6 Slew Rate - Low Speed

6.2.11.6.1 Set the CONTROLLER SPEED switch on G&N Indicator Control Panel to LO.

6.2.11.6.2 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp extinguishes, return OPTICS MODE selector to MANUAL position.

6.2.11.6.3 Record the SHAFT CDU and 2X TRUNNION CDU indications. The optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.6.4 before proceeding. Do not hold control stick at upper limit for more than thirty seconds.

6.2.11.6.4 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its upper limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is lighted and press KEY RLSE on LEB DSKY panel. Immediately record the displays in R1, R2, and R3, In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.5 Record the value of signal b) specified in 6.2.12.5 .1 of the Medium Speed Test.

b) CG 3120 SCT TRUN 1X RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2 and R3 displays when the "MARK" pushbutton is pressed are as follows:
R1 is Shaft Angle as 000.00 ± 900.10 degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R1 is not within ± .10, repeat 6.2.12.6.4

6.2.11.6.6 Compute the respective differences between the R2 and R3 displays recorded in 6.2.11.6.4 as Δ Trun, and Δ Time.

6.2.11.6.7 Compute and record the Trunnion slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Trun}}{\Delta \text{ Time}}$$

6.2.11.6.8 The Trunnion slew rate shall be 0.1 ± 0.02 degrees/second.

6.2.11.6.9 Set OPTICS MODE selector to ZERO OPTICS position. After ZERO ENCODER lamp is extinguished return selector to MANUAL position.

6.2.11.6.10 Record the SHAFT CDU and 2X TRUNNION CDU indications. The Optics CDU readout shall be 000.000 ± 0.006 degrees.

NOTE: Read and understand section 6.2.11.6.11 before proceeding. Do not hold control stick at right limit for more than ten seconds.

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6.2.11.6.11 Insert VERB 06, NOUN 56 and press ENTER on DSKY. Start Analog Recorder chart drive at 5 mm/sec. Push the control stick to its right limit. Two seconds later press the "MARK" pushbutton. Approximately ten seconds after the first mark, again press the "MARK" pushbutton. Release the OPTICS CONTROLLER stick and stop the Analog Recorder. Verify KEY RLSE is displayed. Press KEY RLSE. IMMEDIATELY record the displays in R1, R2 and R3. In a few seconds (approximately 10 seconds), the displays in R1, R2 and R3 change; record the second displays in R1, R2 and R3.

6.2.11.6.12 Record the value of signals c) and d) specified in 6.2.11.5.1 of the Medium Speed test.

b) CG 3130 SCT SHAFT 1X RES ERROR shall be less than 0.200 VRMS

NOTE: The R1, R2 and R3 displays are as follows:
R1 is Shaft Angle as xxx.xx degrees
R2 is Trunnion LOS Angle as xx.xxx degrees
R3 is Time as xxx.xx seconds

NOTE: If R2 is not within 00.000 ± .10, repeat 6.2.11.6.11.

6.2.11.6.13 Compute the respective differences between the R1 and R3 displays recorded in 6.2.11.6.11 as Δ Shaft, and Δ Time.

6.2.11.6.14 Compute and record the Shaft slew rate as the ratio degrees/second.

$$\frac{\Delta \text{ Shaft}}{\Delta \text{ Time}}$$

6.2.11.6.15 The Shaft slew rate shall be 0.2 ± 0.04 degrees/second.

6.2.11.7 AGC Optics Slewing

6.2.11.7.1 Set the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, set the selector to COMPUTER.

6.2.11.7.2 Set up the Analog Recorder 4A3-A2 to monitor the following signals:

a.	CG 3104, SXT TRUNNION TACH FEEDBACK	4A3-A2-1-3
b.	CG 3115, SXT SHAFT TACH FEEDBACK	4A3-A2-7-1
c.	CG 3134, SCT TRUNNION TACH FEEDBACK	4A3-A2-4-3
d.	CG 3124, SCT SHAFT TACH FEEDBACK	4A3-A2-3-2

6.2.11.7.3 Enter the following sequence into K148:

a. VERB 41, NOUN 55, ENTER

b. +27000, ENTER

c. +60000, ENTER

d. VERB 21, NOUN 01, ENTER

e. 00723, ENTER

f. 40000 (do not enter)

6.2.11.7.4 Start the Analog Recorder at 10 mm/sec and depress the ENTER button on the K148. Wait until the transients have died out and stop the Analog Recorder. Record the elapsed time for each signal in 6.2.11.7.2 to reach its final value. In all cases, the elapsed time for the signals in 6.2.11.7.2 shall be less than 50 sec.

6.2.11.7.5 Record the SHAFT and 2X TRUNNION CDU dial indications. The SHAFT CDU shall read 270.0 ± 0.022 degrees. The 2X TRUNNION CDU shall read 120.00 ± 0.01 degrees.

6.2.11.7.6 Place the OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.11.7.7 Verify that G&N System is in the Coarse Align Mode under Computer control.

6.2.12 Optics Coordinate Transformation Control Test

6.2.12.1 Proceed with this test if 6.2.4, Operate Power On Test, or 6.2.2.2., Turn On Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2., Turn On Procedure, before proceeding with this test.

6.2.12.2 Insure that the OPTICS MNA and MNB breakers on the Right Hand Circuit Breaker Panel are pushed in and that the G&N System is in the Coarse Align mode. The COARS ALIGN lamp on the IMU CONTROL Panel shall be the only MODE lamp illuminated.

6.2.12.3 Verify that the TRANSFER switch on the IMU CONTROL Panel is set to COMPUTER.

6.2.12.4 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.12.5 Set the CONTROLLER MODE switch on the G&N Indicator Control Panel to DIRECT.

6.2.12.6 Optics Coordinate Transformation Control Test.

6.2.12.6.1 Using the control stick at desired speed, set SHAFT ANGLE CDU to 225.000 degrees and 2X TRUNNION CDU to 10.000 degrees. Set CONTROLLER SPEED to LO to minimize drift.

6.2.12.6.2 Sight through the SCT eyepiece. Move the movable target so it is centered on the SCT reticle pattern. Maintain 2X TRUNNION CDU at 10.000 ± 0.200 degrees and SHAFT ANGLE CDU at 225.000 ± 0.200 degrees by manipulating control stick.

6.2.12.6.3 Set the switches on the G&N Indicator Control Panel as follows:

a. CONTROLLER MODE TO RESOLVED
b. CONTROLLER SPEED TO MED

NOTE: The following step will require coordination between the K START and Command Module operators. Each should read and thoroughly understand this step before proceeding.

6.2.12.6.4 Simultaneously sight through the SCT eyepiece, quickly displace the CONTROL STICK 45 degrees in the upper right hand quadrant and press the MARK pushbutton. Record the CRT indication of R3. Observe the viewed object and when it leaves the SCT upper rightfield of view press the MARK pushbutton. Record the CRT indications of R1 and R3. R1 indication shall be 225 ± 10 degrees and the difference of the R3 indication shall be 30 ± 6 seconds.

6.2.12.6.5 Set the CONTROLLER MODE switch on the G&N Indicator Control Panel to DIRECT.

6.2.12.6.6 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.12.7 Mark Pushbutton Test

6.2.12.7.1 Using the CONTROL STICK at desired controller speed, set the SHAFT CDU to 60.000 ± 0.010 degrees and 2X TRUNNION CDU to 30.000 ± 0.010 degrees.

6.2.12.7.2 Press the MARK pushbutton on G&N Indicator Control Panel.

6.2.12.7.3 Observe VERB 06 NOUN 56 displayed on CRT.

6.2.12.7.4 The OPTX counter in R1 shall indicate 06000 ± 00003. Record the counter from CRT.

6.2.12.7.5 The OPTX counter in R2 shall indicate 15000 ± 00014. Record the counter from CRT.

6.2.12.7.6 Set the OPTICS MODE selector on the G&N Indicator Control Panel to ZERO OPTICS. After ZERO ENCODER lamp has extinguished, return the selector to MANUAL.

6.2.13 Optics Positional Accuracy Test

6.2.13.1 Proceed with this test if 6.2.4, Operate Power On Test, or 6.2.2.2, Turn On Procedure, has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.1, Turn On Procedure, before proceeding.

NOTE: This test requires the use of G&N Installation Qualification Fixture A23-097 mounted on Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS in accordance with "Alignment of Optical Target GSE on Spacecraft Process Specification No. MA 0201-5036."

Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

Insure that qualified personnel are available outside the Spacecraft to take observations and position the retro-reflecting prism.

6.2.13.2 G&N System shall be in COARSE ALIGN MODE under AGC control. Optics operate power shall be applied by pushing in the OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker panel.

6.2.13.3 Optics controls on the G&N Indicator Control Panel shall be set as follows:

a) CONTROLLER SPEED - LOW
b) CONTROLLER MODE - DIRECT
c) SLAVE TELESCOPE - STAR LOS
d) OPTICS MODE - ZERO OPTICS

NOTE: When directed to use Control Stick to drive optics, set CONTROLLER SPEED selector to position desired and drive optics. Always return selector to LOW position to prevent excessive LOS drift.

6.2.13.4 Resolution Checks

6.2.13.4.1 After ZERO ENCODER lamp has extinguished, set OPTICS MODE switch to MANUAL position.

6.2.13.4.2 Sight on the 5-inch Autocollimator, through the SXT eyepiece. Using the CONTROL STICK to drive the SXT to the approximate position, adjust the TRUNNION and SHAFT ANGLE to view the autocollimator resolution pattern at the center of the field of view.

6.2.13.4.3 Note that the 5-inch autocollimator resolution pattern contains a series of lines of different thickness and width. Each set of lines is marked with a numeral (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space in seconds of arc. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines.

6.2.13.4.3.1 The SXT resolution shall be at least 10 arc seconds at center of field of view.

6.2.13.4.4 Sight through the SCT eyepiece and align the SCT with the control stick until the SCT resolution chart is centered in the field of view, using the SCT and the resolution chart. Record the number of the lowest numbered set distinctly seen with the SCT. The SCT shall demonstrate a resolution of at least 3 arc minutes at center of field of view.

6.2.13.5 Slave Telescope Mode Checks

6.2.13.5.1 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, return selector to MANUAL position. Verify SLAVE TELESCOPE switch is in the STAR LOS position.

6.2.13.5.2 Record SCT Shaft and Trunnion Angles on the TPAC and the SHAFT and 2X TRUNNION CDU indications. The difference between TPAC angles and corresponding CDU angles shall be less than 0.5 degrees.

NOTE: TPAC TRUNNION angle counter reading indicates LOS angles and 2X TRUNNION CDU angle reading indicates 2X LOS angle. The 2X TRUNNION CDU indication must be divided by two before subtracting from SCT TRUNNION display.

6.2.13.5.3 Using Control Stick, drive 2X TRUNNION and SHAFT CDU's to 35.500 degrees. Record TPAC shaft angle (35.5 ± 0.5 degrees) and Trunnion angle (17.75 ± 0.25 degrees) on the TPAC.

6.2.13.5.4 Repeat 6.2.13.5.1

6.2.13.5.5 Set SLAVE TELESCOPE Switch to LANDMARK LOS 0°.

6.2.13.5.6 Remove the plug from the base of SXT eyepiece. Install the Adapter Assembly and Portable Light Assembly in this location. Turn on the light.

NOTE: It will be necessary for the optics operator to communicate with the personnel outside the Spacecraft handling the optical GSE (Retroreflecting Prism, Autocollimator, etc.) through 6.2.13.8.2.

If needed to reduce external light, obtain, place, and secure a photographer's hood over the optics head and the retroreflecting prism.

6.2.13.5.7 Sight through the SCT eyepiece and give direction for positioning the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS, so that the illumination from the backlight filament is clearly visible at the center of the field. The prism must be held in this position until after completion of Step 6.2.13.5.12.

6.2.13.5.8 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle should be visible for alignment comparison with the SXT reticle. Adjust the 2X TRUNNION CDU with OPTICS CONTROL Stick to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the 2X TRUNNION CDU angle. The difference between this angle and the corresponding angle recorded in Step 6.2.13.5.2 shall be less than ± .440 degrees.

6.2.13.5.9 Replace the Portable Light in the adapter in the SXT eyepiece.

6.2.13.5.10 Readjust the 2X TRUNNION CDU to obtain the values ± .002 degrees recorded in Step 6.2.13.5.2 (at the zero optics position). Then set SLAVE TELESCOPE Switch to STAR LOS.

6.2.13.5.11 To temporarily disable the electrical drive to the SCT TRUNNION, carefully unscrew the SCT TRUNNION Manual Drive item until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

6.2.13.5.12 Verify that the Retroreflecting Prism is still in the desired position as in Step 6.2.13.5.7 by sighting into the SCT eyepiece. Then remove the Portable Light from the adapter and again direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in Step 6.2.13.5.8. Again observe the positions of the SCT and SXT reticles and adjust the 2X TRUNNION CDU with CONTROLLER Stick to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the 2X TRUNNION CDU angle. The difference between this angle and the corresponding angle recorded in Step 6.2.13.5.2 shall be less than ± .440 degrees. Replace the Portable Light in the adapter.

6.2.13.5.13 Replace the SCT TRUNNION Manual Adjust drive in the panel.

6.2.13.5.14 Use the Control Stick to drive the 2X TRUNNION CDU to 50.000 ± 0.005 degrees.

6.2.13.5.15 Set SLAVE TELESCOPE Switch to OFFSET 25°. After 30 seconds has elapsed from time of switch operation, record TPAC TRUNNION angle and CDU 2X TRUNNION angle. The difference shall be 25° ± 0.5 degrees. Also record CDU SHAFT angle.

6.2.13.5.16 To temporarily disable the electrical drive to the SCT TRUNNION and SCT SHAFT, carefully unscrew the SCT TRUNNION and SCT SHAFT Manual Drive item until they just release from the panel. Do not rotate further as this would displace the SCT LOS from the desired reference position.

6.2.13.5.17 For this step it is necessary to reposition the Retroreflecting Prism so that it is inclined at an angle 25° downward in such a position as to span the SCT LOS and the SXT StLOS. After the prism has been moved to the approximate position described above, again sight into the SCT eyepiece and give direction as necessary to adjust the prism position so that the illumination from the backlight filament is again visible at the center of the field. Then remove the Portable Light Assembly (from the SXT eyepiece adapter) and sight through the SXT eyepiece while directing the light assembly into the SCT eyepiece. Again observe the comparison of SCT and SXT reticles. Adjust the 2X TRUNNION CDU and the SHAFT CDU with OPTICS CONTROLLER Stick to bring the two reticle patterns into coincidence. Record the 2XTRUNNION CDU angle and the SHAFT CDU angle. The difference between each of these two angles and the corresponding values recorded in Step 6.2.13.5.6 shall be less than ± .440 degrees. Replace the SCT TRUNNION and SHAFT Manual Adjust drive in panel.

6.2.13.5.18 Replace Portable Light Assembly in the adapter. Set SLAVE TELESCOPE switch to STAR LOS. Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, return selector to MANUAL position. Verify SLAVE TELESCOPE Switch is in the STAR LOS position. Remove hood (if used) and Retroreflecting Prism.

6.2.13.6 Sextant Parallelism Tests

6.2.13.6.1 Using Control Stick (with CONTROLLER SPEED switch HI), drive SXT StLOS to 30.000 ± 2.0 degrees as indicated on the 2X TRUNNION CDU.

6.2.13.6.2 Insure that SHAFT CDU readout indicates 000.000 ± 0.006 degrees. Use Control Stick to correct it, if required.

6.2.13.6.3 Sight through the autocollimator eyepiece and superimpose the sextant horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.

6.2.13.6.4 Repeat 6.2.13.6.3 twice and record the average of the three autocollimator readings.

6.2.13.6.5 Set OPTICS MODE selector to ZERO OPTICS. Return selector to MANUAL position after ZERO ENCODER lamp is extinguished on the Condition Annunciator Panel.. Insure that 2X TRUNNION CDU readout indicates 000.000 ± 0.006 degrees, and SHAFT ANGLE CDU indicates 000.000 ± .006 degrees. Correct if necessary. Record 2X TRUNNION and SHAFT CDU indications.

6.2.13.6.6 Again sight through 5 inch autocollimator eyepiece and adjust the horizontal filar (not autocollimator) to bring StLOS horizontal reticle line and filar horizontal image to coincidence. Record the average of three filar position indications. This reading shall not differ from that obtained in 6.2.13.6.4 by more than 15 arc seconds.

6.2.13.7 Shaft and Trunnion Positional Accuracy Checks

6.2.13.7.1 Set OPTICS MODE selector to ZERO OPTICS. Return selector to MANUAL position after ZERO ENCODER lamp is extinguished.

6.2.13.7.2 Enter VERB 41, NOUN 55 into the K- 148. Press ENTER pushbutton. The VERB-NOUN display shall indicate 21-57 flashing on CRT.

6.2.13.7.3 Enter 00400 into the K- 148. Press ENTER pushbutton. Enter 00200 into the K- 148. Press ENTER pushbutton. The VERB-NOUN display on CRT shall stop flashing.

6.2.13.7.4 Enter VERB 14, NOUN 55 into K- 148. Press ENTER pushbutton. Record the value of the SHAFT and TRUNNION CDU counters in R1 and R2 on CRT.

6.2.13.7.5 Record SHAFT and 2X TRUNNION CDU indications.

6.2.13.7.6 Set OPTICS MODE selector to ZERO OPTICS. After ZERO ENCODER lamp is extinguished, return selector to MANUAL.

6.2.13.7.7 Using Optics Hand Controller, set SHAFT and 2X TRUNNION CDU's to the values recorded in 6.2.13.7.5.

6.2.13.7.8 Record the value of the SHAFT and TRUNNION CDU counters in R1 and R2 on CRT.

6.2.13.7.8.1 The values of 6.2.13.7.8 shall differ from those of 6.2.13.7.4 by no more than ± 00005.

NOTE: Read and understand 6.2.13.7.9 before proceeding.

6.2.13.7.9 Sight through the SXT. Using Control Stick, align the SXT StLOS with optical target No. 1 (approximately 2X TRUNNION 106.650 degrees, SHAFT ANGLE 118.500 degrees) on the G&N Installation Qualification Fixture Model No. A23-097. At the instant of coincidence, simultaneously press "MARK" pushbutton and read the SHAFT TRUNNION CDU indication.

NOTE: VERB 06, NOUN 56 shall appear on DSKY indicating optical CDU and time displays.

6.2.13.7.10 Record the SHAFT angle as indicated on R1 and TRUNNION angle as indicated on R2 of LEB DSKY. Record the SHAFT and 2X TRUNNION CDU indication.

6.2.13.7.10.1 Repeat 6.2.13.7.9 through 6.2.13.7.10 two more times. If two of the specific recorded angles are equal, record this angle. If all three of the recorded angles are different, select the value that is between the higher and lower values.

6.2.13.7.11 Sight through the SXT. Using Control Stick, align the SXT StLOS with Optical Target No. 2 (approximately 2X TRUNNION 106.650 degrees and SHAFT ANGLE 241.500 degrees) on A23-097. At the instant of coincidence, simultaneously press "MARK" pushbutton and read SHAFT and TRUNNION CDU.

NOTE: VERB 06, NOUN 56 shall appear on DSKY.

6.2.13.7.12 Record the SHAFT angle as indicated on R1 and TRUNNION angle as indicated on R2 of LEB DSKY. Record the SHAFT and 2X TRUNNION CDU indication.

6.2.13.7.12.1 Repeat 6.2.13.7.11 through 6.2.13.7.12 two more times. If two of the specific recorded angles are equal, record this angle. If all three of the recorded angles are different, select the value that is between the higher and lower values.

6.2.13.7.13 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished, set selector to COMPUTER position.

6.2.13.7.14 Enter VERB 41, NOUN 55 into K- 148. Press ENTER pushbutton. VERB-NOUN display shall flash 21-57.

6.2.13.7.15 Enter the value recorded from R1 in 6.2.13.7.10.1 into K- 148. Press ENTER pushbutton.

6.2.13.7.16 Enter the value recorded from R2 in 6.2.13.7.10.1 into K- 148. Press ENTER pushbutton.

6.2.13.7.17 Sight through the SXT. The StLOS should be centered on Optical Target No. 1 on A23-071. Record SHAFT and 2X TRUNNION CDU indications.

6.2.13.7.18 Enter VERB 41, NOUN 55 into K- 148. Press ENTER pushbutton. VERB-NOUN displays shall flash 21-57.

6.2.13.7.19 Enter the value recorded from R1 in 6.2.13.7.12.1 into the K- 148. Press ENTER pushbutton.

6.2.13.7.20 Enter the value recorded from R2 in 6.2.13.7.12.1 into the K- 148. Press ENTER pushbutton.

6.2.13.7.21 Sight through the SXT. The StLOS should be centered on Optical Target No. 2 on A23-071. Record SHAFT and 2X TRUNNION CDU indications.

6.2.13.7.22 The difference between the SHAFT CDU indications from 6.2.13.7.10.1 and 6.2.13.7.17 shall not exceed 0.025 degrees. Record this difference.

6.2.13.7.22.1 The difference the 2X TRUNNION CDU indications from 6.2.13.7.10.1 and 6.2.13.7.17 shall not exceed 0.025 degrees. Record this difference.

6.2.13.7.22.2 The difference between the SHAFT CDU indications from 6.2.13.7.12.1 and 6.2.13.7.21 shall not exceed 0.025 degrees. Record this difference.

6.2.13.7.22.3 The difference between the 2X TRUNNION CDU indications from 6.2.13.7.12.1 and 6.2.13.7.21 shall not exceed 0.025 degrees. Record this difference.

6.2.13.8 SXT StLOS-ILOS Parallelism Test, 90 Degree Position

6.2.13.8.1 Set the OPTICS MODE selector to ZERO OPTICS position. After the ZERO ENCODER lamp is extinguished, set selector to MANUAL position.

6.2.13.8.2 Set CONTROLLER SPEED to MEDIUM. Using Control Stick, drive the SXT TRUNNION axis until the 2X TRUNNION CDU indicates 175 ± 5 degrees.

6.2.13.8.3 Set CONTROLLER SPEED to LO and drive the 2X TRUNNION CDU until it indicates 180.000 degrees. Insure that the SHAFT CDU indicates 0.000 ± 0.006 degrees.

6.2.13.8.4 If necessary, cover the optics head with a photographer's hood (or any acceptable substitute) to block stray light from the sextant head.

6.2.13.8.5 Turn on SXT Portable Light Assembly

6.2.13.8.6 Sight through the SXT. Two reticle patterns shall be visible. Use the Optics Hand Controller to adjust the SXT TRUNNION axis until the two horizontal reticle lines are coincident. Record the 2X TRUNNION angle.

6.2.13.8.6.1 The 2X TRUNNION CDU shall indicate 180.000 ± 0.020 degrees.

6.2.13.8.7 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace Sextant eyepiece plug.

6.2.13.9 Set OPTICS MODE selector to ZERO OPTICS. After the ZERO ENCODER lamp is extinguished on the Condtion Annunciator Panel, return selector to MANUAL position.

6.2.13.10 Verify that the SHAFT CDU and 2X TRUNNION CDU indications on the OPTICS CDU readout indicate 000.000 ± 0.006 degrees.

6.2.13.11 Remove OPTICS power by pulling out OPTICS MNA and MNB breakers or Right Hand Circuit Breaker panel.

6.2.14 **AGC Mode Control Test**

6.2.14.1 Proceed with this test if 6.2.4 Operate Power on Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.14.2 Verify that the TRANSFER switch is set to COMPUTER and COARSE ALIGN is the only mode lamp lighted.

6.2.14.3 Verify that the MODE pushbutton on the IMU CONTROL panel will not effect a mode change by pressing each button not lighted. The COARS ALIGN MODE lamp shall remain lighted.

6.2.14.4 Zero Encode Mode

6.2.14.4.1 Enter VERB 25, NOUN 22 into K- 148. Press the ENTER pushbutton.

6.2.14.4.2 Enter +04000 into K- 148. Press the ENTER pushbutton.

6.2.14.4.3 Enter +04000 into K-148. Press the ENTER pushbutton.

6.2.14.4.4 Enter +04000 into K- 148. Press the ENTER pushbutton.

6.2.14.4.5 Wait 30 seconds.

NOTE: Perform 6.2.14.4.6 through 6.2.14.4.10 within 30 seconds.

6.2.14.4.6 Enter VERB 40, NOUN 20 into K- 148. Press the ENTER pushbutton.

6.2.14.4.7 Verify the K Relays on CRT indicate 001001 immediately after pushing ENTER pushbutton. Record.

6.2.14.4.8 Verify that the INNER, MIDDLE, and OUTER Gimbal CDU's indicate 000.000 ± 1.00 degrees. Record.

6.2.14.4.9 Enter VERB 15, NOUN 20 into K- 148. Press the ENTER pushbutton.

NOTE: (a) KEY RELEASE and CHECK FAIL will be lighted. Press KEY RELEASE on DSKY.

(b) CDU FAIL will momentarily light on Condition Annunciator Panel.

6.2.14.4.10 Verify that the contents of R1, R2, and R3 on CRT indicate all zeros. Record.

6.2.14.4.11 Verify ZERO ENCODER on Condition Annunciator Panel has extinguished before proceeding.

6.2.14.5 **Coarse Align Mode**

6.2.14.5.1 Enter VERB 41, NOUN 20 into K-148. Press the ENTER pushbutton.

6.2.14.5.2 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.3 Enter +00000 into K-148. Press the ENTER pushbutton.

6.2.14.5.4 Enter +00000 into K-148. Press the ENTER pushbutton. Wait 60 seconds.

NOTE: The PGNS lamp will light on the Condition Annunciator Panel. Disregard lamp indication.

6.2.14.5.5 Set up the Analog Recorder 4A3-A2 to monitor the following signals:

Signal

a. CG 2110 IGA TORQUE MOTOR INPUT

b. CG 2140 MGA TORQUE MOTOR INPUT

c. CG 2170 OGA TORQUE MOTOR INPUT

6.2.14.5.6 Enter (and verify) VERB 41, NOUN 20 (COARSE ALIGN) into K-148. Press ENTER pushbutton.

6.2.14.5.7 Enter +06000 into K-148 twice. Press ENTER pushbutton after each entry.

6.2.14.5.8 Start Analog Recorder 4A3-A2. Enter +06000 into K-148. Press ENTER pushbutton.

NOTE: The GIMBAL LOCK lamp on the Condition Annunciator and PROGRAM alarm lamp on LEB DSKY may light. Press ERROR RESET pushbutton and continue.

6.2.14.5.9 After the transients have died out, stop Analog Recorder 4A3-A2. Determine the time elapsed on each signal specified in 6.2.14.5.5 between the initial and final transients. Record elapsed times. The elapsed times for IGA, OGA, and MGA to drive from zero degrees to 60 degrees shall be no greater than 21 seconds.

6.2.14.5.10 Verify that the K Relays on CRT indicate 000010. Record.

6.2.14.5.11 Record IMU-CDU DIFFERENCE meter indications for the INNER, MIDDLE, and OUTER GIMBAL channels. The INNER, MIDDLE, and OUTER indicators in the IMU-CDU DIFFERENCE meter shall be 0 ± 1.0 degrees.

6.2.14.5.12 Record the indicated value of the following signals in Table VII on the CRT.

Table VII Signal Voltage Requirements

	Signals	Requirements
1.	CG 2206 IGA CDU IX RES ERROR	0.0 to .210 VRMS
2.	CG 2236 MGA CDU IX RES ERROR	0.0 to .210 VRMS
3.	CG 2266 OGA CDU IX RES ERROR	0.0 to .210 VRMS
4.	INNER GIMBAL ANGLE	60 ± 2.5 degrees
5.	MIDDLE GIMBAL ANGLE	60 ± 2.5 degrees
6.	OUTER GIMBAL ANGLE	60 ± 2.5 degrees
7.	CG 2209 SCS PITCH	0.0 ± 1.00 degrees
8.	CG 2239 SCS YAW BODY AXIS	0.0 ± 1.00 degrees
9.	CG 2241 SCS YAW OFFSET AXIS	0.0 ± 1.00 degrees
10.	CG 2269 SCS ROLL BODY AXIS	0.0 ± 1.00 degrees
11.	CG 2271 SCS ROLL OFFSET AXIS	LLL to UUU degrees

6.2.14.6 Fine Align Mode

NOTE: **The Program Alarm and GIMBAL LOCK indication may be present during the duration of the FINE ALIGN Mode test.**

6.2.14.6.1 Enter (and verify) VERB 42 into K-148. Press ENTER pushbutton to advance G&N to the FINE ALIGN mode. The VERB-NOUN display shall indicate 21-67 flashing.

6.2.14.6.2 Enter +00000 three times pressing ENTER pushbutton after each entry into K-148. Press ENTER pushbutton. Verify VERB-NOUN display shall stop flasing. The FINE ALIGN MODE lamp on the IMU CONTROL Panel is the only MODE lamp that is lighted.

6.2.14.6.3 Record the indicated values of the following signals in Table VIII on the CRT.

Table VIII Voltage Requirements

	Signals	Requirements
a.	CG 2204 IGA CDU 16X RES ERROR	0.0 to .125 VRMS
b.	CG 2234 MGA CDU 16X RES ERROR	0.0 to .125 VRMS
c.	CG 2264 OGA CDU 16X RES ERROR	0.0 to .125 VRMS
d.	CG 2107 OGA SERVO ERROR	0.0 to .23 VRMS
e.	CG 2137 MGA SERVO ERROR	0.0 to .23 VRMS
f.	CG 2167 OGA SERVO ERROR	0.0 to .23 VRMS

NUMBER	REVISION LETTER	PAGE

6.2.14.6.3 (continued)

Table III Voltage Requirements

Signals	Requirements
g. CG 2209 SCS PITCH ERROR	0 ± 1.00 degrees
h. CG 2239 SCS YAW BODY AXIS	0 ± 1.00 degrees
i. CG 2241 SCS YAW OFFSET AXIS	0 ± 1.00 degrees
j. CG 2269 SCS ROLL BODY AXIS	0 ± 1.00 degrees
k. CG 2271 SCS ROLL OFFSET AXIS	LLL to UUU degrees

6.2.14.6.4 Record the INNER, MIDDLE, and OUTER GIMBAL CDU indications. The INNER, MIDDLE, and OUTER indicator on the IMU-CDU DIFFERENCE meter shall be 0.0 ± 1.0 degrees.

6.2.14.6.5 Verify that the K-RELAYS on CRT indicate 001000.

6.2.14.6.6 Insert the following into LEB DSKY.

a. Insert VERB 41, NOUN 20 ENTER
b. Insert +00000, ENTER
c. Insert +00000, ENTER
d. Insert +00000, ENTER
e. Wait 60 seconds.

Observe that Gimbal Lock lamp extinguishes, if Prog Alarm is lighted, press Error Reset.

6.2.15 Gimbal Friction Test

6.2.15.1 Obtain the Gimbal Friction Test Tape No. F02C017-K00031-XX and install on TAPE READER.

6.2.15.2 Set the POWER/ON Switch on the TAPE READER 4A4-A2 to ON. Perform the following steps on Console 4A4-A3 in sequence:

a. Press the TAPE/KEY indicator to TAPE.
b. Press the FWD/REV indicator to FWD.
c. Press the IND/CONT indicator to CONT.
d. Press the LOAD/INH indicator to LOAD.

6.2.15.3 Set up Analog Recorder 4A1-A3 to monitor the following signals:

a. CG 2110 IGA TM IN
b. CG 2140 MGA TM IN
c. CG 2170 OGA TM IN

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6.2.15.4 Press RUN indicator on K-148. Wait 90 seconds after tape stops.

6.2.15.5 Press RUN indicator on K-148. Wait 60 seconds after tape stops.

6.2.15.6 Press RUN indicator on K-148. Wait for tape to stop.

6.2.15.7 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate IG Clockwise Friction Test. After about 9 minutes observe, CRT. When IG CDU angle indication stops changing, stop analog recorder. IG CDU angle should be 000 ± 010 degrees.

6.2.15.8 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.9 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate IG Counter clockwise Friction Test. After about 9 minutes observe CRT. When IG CDU angle stops changing, stop analog recorder. IG CDU angle should be 000 ± 010 degrees.

6.2.15.10 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.11 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate OG Clockwise Friction Test. After about 9 minutes, observe CRT. When OG CDU angle stops changing, stop analog recorder. OG CDU angle should be 000 ± 010 degrees.

6.2.15.12 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.13 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate OG Counter-clockwise Friction Test. After about 9 minutes, observe CRT. When OG CDU angle stops changing, stop analog recorder. OG CDU angle should be 000 ± 010 degrees.

6.2.15.14 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.15 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate MG Clockwise Friction Test. After about 3 minutes, observe CRT. When MG CDU angle stops changing, stop analog recorder. MG CDU angle should be +050 ± 010 degrees.

6.2.15.16 Repeat 6.2.15.5 and 6.2.15.6.

6.2.15.17 Start Analog Recorder 4A1-A3 at 5 mm/sec. Press RUN indicator on K-148 to initiate MG Counter-clockwise Friction Test. After about 3 minutes, observe CRT. When MG CDU angle stops changing, stop analog recorder. MG CDU angle should be +310 ±010 degrees.

6.2.15.18 Press RUN indicator on K- 148. Wait for tape to stop and remove from TAPE READER.

6.2.15.19 Observe the six active traces on the analog recorder. Determine that none of the traces indicate greater than 7.5 VDC for a period not to exceed 5MM throughout the range of the active trace.

6.2.16 Stabilization Loop Step Response Test

6.2.16.1 Proceed with this test if 6.2.4, Operate Power On Test has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedures before proceeding. Ensure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.16.2 Ensure G&N System is in the COARSE ALIGN mode under AGC control.

6.2.16.3 Set the TRANSFER switch on the IMU CONTROL Panel to COMPUTER.

Note: The computer PROGRAM ALARM will be lighted. Disregard and press ERROR RESET button on LEB DSKY.

6.2.16.5 Inner Gimbal Response Test

6.2.16.5.1 Enter the code 2 010 000 000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2107 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.16.5.2 Insert the following sequence into K148:

a. VERB 41, NOUN 20, ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

Wait 60 seconds

6.2.16.5.3 Insert VERB 36 into K148. Press ENTER pushbutton.

6.2.16.5.4 Enter 1000 into 4A2-A6-R155. The top part of switch should be lighted. Ensure that no other function switches on 4A2-A6-R155 are lighted.

6.2.16.5.5 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a 2 ± 0.2 VDC step into the IG Stabilization Loop.

NOTE: If the transient cause by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MN A & MN B circuit breaker on the right hand circuit breaker panel.

6.2.16.5.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.

6.2.16.5.7 Enter 0000 into 4A2-A6-R155; the top part of switch should be out. Ensure that no other function switches on 4A2-A6-155 are lighted. Press XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall go out.

6.2.16.5.8 After transient has died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.16.5.8.1 The Inner Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.5.8.2 The maximum number of overshoots on the torque motor input signals shall be two.

6.2.16.6 Middle Gimbal Response Test

6.2.16.6.1 Enter the code 2 021 000 000 into C-START MODULE 4A1-A5-0156. Press the XEQ/SEAL pushbutton to call up CG 2137 MGA SERVO ERROR on 4A1-A3-CH1.

6.2.16.6.2 Insert the following sequence into K148

a. VERB 41, NOUN 20 ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

Wait 60 seconds

6.2.16.6.3 Insert VERB 36 into K148. Press ENTER pushbutton.

6.2.16.6.4 Enter 0100 into 4A2-A6-R155 to enter a 2.0 ± 0.2 VDC step into the MG Stabilization Loop.

NOTE: If the transient caused by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA & MNB circuit breaker on the Right Hand Circuit Breaker panel.

6.2.16.6.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.

6.2.16.6.7 Enter 0000 into 4A2-A6-R155. The top part of switch shall go out. Ensure that no other function switches on 4A2-A6-R155 are lighted. Press the XEQ/SEAL pushbutton to remove the step input to the MG Stabilization Loop.

6.2.16.6.8 After transients have died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.16.6.8.1 The Middle Gimbal stabilization loop response time shall be less' than 0.8 seconds.

6.2.16.6.8.2 The maximum number of overshoots on the torque motor input signals shall be two.

6.2.16.7 Outer Gimbal Response Test

6.2.16.7.1 Enter the code 2 025 000 000 C-START Module 4A1-A5-C156. Press XEQ/SEAL pushbutton to call up CG 2167 OGA SERVO ERROR On 4A1-A3-CH1.

6.2.16.7.2 Insert the following sequence into K148.

a. VERB 41, NOUN 20, ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

Wait 60 seconds

6.2.16.7.3 Insert VERB 36 into K148. Press ENTER pushbutton.

6.2.16.7.4 Enter 0010 into 4A2-A6-R155. The top half of switch should be lighted. Ensure that no other function switches on 4A2-A6-R155 are lighted.

6.2.16.7.5 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a 2.0 + 0.2 VDC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 5 seconds, remove IMU OPERATE power by opening the IMU MNA & MNB circuit breaker on the Right Hand Circuit Breaker Panel.

6.2.16.7.6 Start Analog Recorder 4A1-A3 using a chart speed of 20 MM/SEC.

6.2.16.7.7 Enter 0000 into 4A2-A6-R155. The top half of switch shall go out. Ensure that no other function switches on 4A2-A6-R155 are lighted. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.16.7.8 After transients have died out, stop Analog Recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the peak of the first overshoot. In addition, record the total number of overshoots.

6.2.16.7.8.1 The Outer Gimbal stabilization loop response time shall be less than 0.8 seconds.

6.2.16.7.8.2 The maximum number of overshoots on the OGA SERVO ERROR signals shall be two.

6.2.16.8 Insert the following sequence into K148

a. VERB 41, NOUN 20 ENTER

b. +00000 ENTER

c. +00000 ENTER

c. +00000 ENTER

6.2.17 IRIG Scale Factor Test

6.2.17.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 before proceeding.

6.2.17.2 Set up Analog Recorders 4A3-A2 and 4A1-A2 to monitor the following signals:

	Analog Recorder
a. CG 2110 IG TM INPUT	4A3-A2
b. CG 2140 MG TM INPUT	4A3-A2
c. CG 2170 OG TM INPUT	4A3-A2
d. CG 2117 IG SERVO ERROR	4A1-A2
e. CG 2147 MG SERVO ERROR	4A1-A2
f. CG 2177 OG SERVO ERROR	4A1-A2

6.2.17.3 Start Analog Recorder chart drive using a speed of 1 MM/Second. Recorder shall run for duration of this test.

6.2.17.4 Insert and verify the following sequence into K148.

VERB 57 ENTER

00005 ENTER

Observe 07 in MAJOR MODE

6.2.17.5 VERB 21 NOUN 30 shall flash on CRT requesting a load of the test numbers. Select the desired Test Number from Table XVIII. Enter the appropriate ±0000X into K148. Press the ENTER pushbutton.

Table XVIII. Test Numbers and Positions for IRIG Tests

Test Number	Gyro being tested and direction of torque
+00001	+X
-00001	-X
+00002	+Y
-00002	-Y
+00003	+Z
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in the above table. If only one gyro is being tested, the test need only be repeated for the two applicable Test Numbers.

6.2.17.6 During the following operation, disregard the CDU FAIL lamp indication unless specified:

The G&N System will automatically cycle through ZERO ENCODE, FINE ALIGN, ATT CONT, FINE ALIGN, COARS ALIGN, AND FINE ALIGN Modes. When alignment is completed for the specific IRIG under test, it will be torqued through approximately 360 degrees. There are six cycles of approximately 20 minutes each, which correspond to both plus and minus configurations of the X, Y, and Z IRIG's. The approach time period for one cycle test completion can be observed by performing the following sequences:

a. Insert Verb 11, NOUN 01 into K148. Press ENTER pushbutton.

b. Insert 01571 into K148. Press ENTER pushbutton.

c. Verify on CRT that R1 is counting down octally. When R1 has counted to zero, VERB 07 and NOUN 30 will be flashing. This indicates completion of one of the six cycles.

6.2.17.7 Record the value displayed in register R1 CRT for the appropriate Test Number in Table XIX.

Table XIX. Display of Test Parameters

Test Number	Symbol	Display in R1
+00001	ΔE_{-X}	$\pm$ X X X X X
-00001	ΔE_{+X}	$\pm$ X X X X X
+00002	ΔE_{-Y}	$\pm$ X X X X X
-00002	ΔE_{+Y}	$\pm$ X X X X X
+00003	ΔE_{-Z}	$\pm$ X X X X X
-00003	ΔE_{+Z}	$\pm$ X X X X X

6.2.17.8 Enter VERB 36 into K148. Press the ENTER pushbutton. Press The ERROR RESET switch on the LEB AGC DSKY.

6.2.17.9 Repeat 6.2.17.4 through 6.2.17.8 until all Test number in Table XVIII have been utilized.

6.2.17.10 After all completion of all test numbers, stop the Analog Recorder.

6.2.17.10.1 Enter VERB 40, NOUN 20 into K148. Press ENTER pushbutton. Wait 90 seconds.

6.2.17.10.2 Enter VERB 41, MOUN 20 into K148. Press ENTER pushbutton.

6.2.17.10.3 Enter +00000 into K148, three times, press ENTER pushbutton after each entry.

6.2.17.11 Perform the following calculations:

a. X IRIG Scale Factor Error

$$X_E = \frac{\Delta E_{+X} + \Delta E_{-X}}{2}$$

________ parts/million

b. Y IRIG Scale Factor Error

$$Y_E = \frac{\Delta E_{+Y} + \Delta E_{-Y}}{2}$$

________ parts/Million

6.2.17.12 c. Z IRIG Scale Factor Error

$$Z_E = \frac{\Delta E_{+Z} + \Delta E_{-Z}}{2}$$ ______parts/million

6.2.17.12.1 The Scale Factor error deviation for each IRIG shall be less than ± 1750 parts/million.

6.2.18 PIPA Scale Factor Determination Test

6.2.18.1 Proceed with this test if 6.2.2 Operate Power On Test or 6.2.2.2 Turn On Procedure has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn on Procedure before proceeding with this test.

6.2.18.2 Verify the IMU OPERATE power has been applied and that the IMU TEMP MODE switch has been in the AUTO OVERRIDE or PROPORTIONAL for a minimum of one hour.

6.2.18.3 Verify that the TRANSFER switch is set to COMPUTER position.

6.2.18.4 Test Initiation

6.2.18.4.1 Insert and verify the following sequence into K-148

a. VERB 57 ENTER

b. 00002 ENTER

Observe 07 in MAJOR MODE.

6.2.18.4.2 Observe VERB 06, MOUN 61 flashing. Rows R1 and R2 contain the NB azimuth and lattitude respectively in degrees. If R1 and R2 agree with known azimuth and lattitude insert VERB 33, ENTER into K148 and proceed to 6.2.18.4.4.

6.2.18.4.3 Insert and verify the following sequence into K148.

a. VERB 21 ENTER

b. +X X X X X (Correct NB azimuth) ENTER

c. VERB 22 ENTER

d. +28523 (Correct NB lattitude) ENTER

e. VERB 33 ENTER

6.2.18.4.4 Observe VERB 06 NOUN 66 flashing. Rows R1, R2, and R3 shall indicate:

R1 + 00032 (NB Tilt angle)
R2 - 00000 (Test Index)
R3 + 0000X (Test Position)

Where X indicates positions 1 through 6.

NOTE: To complete this test, positions 1 through 6 shall be performed.

If R1, R2 and R3 agree with the above, insert VERB 33, ENTER into K148 and proceed to 6.2.18.4.6.

6.2.18.4.5 Insert and verify the following sequence into K148.

a.	VERB 21, NOUN 02	ENTER
b.	01231	ENTER
c.	+00032 (Correct NB tilt)	ENTER
d.	VERB 21, NOUN 01	ENTER
e.	01232	ENTER
f.	-00000 (Correct Index)	ENTER
g.	VERB 21 NOUN 02	ENTER
h.	01223	ENTER
i.	+0000X (position)	ENTER
j.	VERB 33	ENTER

6.2.18.4.6 After approximately 5 minutes record CRT indications of OG, IG and MG CDU angles.

6.2.18.4.7 After approximately 18 minutes, VERB 06 NOUN 66 will appear flashing Record R1 (XXXXX), R2 (.XXXXX) and R3 (position number).

Table XXI

Position No. as Displayed in R3	PIPA Being Tested and its Orientation
00001	X PIPA Up
00002	X PIPA Down
00003	Z PIPA Up
00004	Z PIPA Down
00005	Y PIPA Up
00006	Y PIPA Down

6.2.18.4.8 If it is desired to perform the test in the next position, enter VERB 33 into K148. Press the ENTER pushbutton and return to 6.2.18.4. After completion of position 6, the test shall be terminated by entering VERB 34 into K148. Press the ENTER pushbutton.

6.2.18.4.9 Enter VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.18.4.10 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.18.4.11 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.18.4.12 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.18.4.13 Enter +00000 into K148. Press the ENTER pushbutton. The COARS ALIGN mode lamp shall light.

6.2.18.5 Calculations

6.2.18.5.1 The values obtained from R1 and R2 for each position are combined as follows:

Contents of $(R1)_1$ Contents of $(R2)_1$

A_1 = ± X X X X X X X X X X

Where 1 = Position Number

A_1 = ------.-----
A_2 = ------.-----
A_3 = ------.-----
A_4 = ------.-----
A_5 = ------.-----
A_6 = ------.-----

6.2.18.5.2 Compute the average G for each PIPA using A_1 from step 1:

a. for X - PIPA $G_x = \frac{A_1 - A_2}{2} =$

b. for Z - PIPA $G_z \quad \frac{A_3 - A_4}{2} =$

c. for Y -PIPA $G_y \quad \frac{A_5 - A_6}{2} =$

6.2.18.5.3 Compute the PIPA scale factors using five significant figures from 6.2.18.5.2 and the value of local gravity obtained from Table XXII.

$$h_x = \frac{5.85\ (\text{local } g)}{G_x} = \underline{\qquad\qquad}$$

$$h_z = \frac{5.85\ (\text{local } g)}{G_z} = \underline{\qquad\qquad}$$

$$h_y = \frac{5.85\ (\text{local } g)}{G_y} = \underline{\qquad\qquad}$$

6.2.18.5.3.1 These values shall fall within 400 PPM of the nominal SF of 5.65 cm/sec/pulse.

6.2.18.5.4 Compute the PIPA biases using the values computed in 6.2.18.5.1 and 6.2.18.5.2 as follows:

$$b_x = \frac{(A_1 + A_2)}{2} = \underline{\qquad\qquad}$$

$$b_z = \frac{(A_3 + A_4)}{2} = \underline{\qquad\qquad}$$

$$b_y = \frac{(A_5 + A_6)}{2} = \underline{\qquad\qquad}$$

6.2.18.5.4.1 These values shall fall within 0.0 ± 0.50 cm/sec^2.

Table XXII. Local Gravity Requirements	
Location	Local Gravity (cm/sec^2)
KSC	979.24

[illegible] or [illegible].

[illegible] Determination Test has [illegible].

6.2.19. IRIG Coefficient Determination Test

6.2.19.1 Proceed with this test if 6.2.4 Operate Power On Test or 6.2.2.2 Turn On Procedure has been performed, and system operation has not been interrupted. If system operation has been interrupted, perform Turn On Procedure of 6.2.2.2 before Proceeding with this test.

6.2.19.2 Verify or set transfer switch to COMPUTER.

6.2.19.3 Obtain, verify and record the azimuth orientation of Spacecraft Z Axis.

6.2.19.4 Insert and verify the following sequence into K148.

a. VERB 57 ENTER

b. Observe VERB 21, NOUN 01 Flashing

c. 00001 ENTER

d. Observe 07 in MAJOR MODE

6.2.19.5 Observe VERB 06, NOUN 61 flashing. Rows R1 and R2 shall contain the nav base azimuth and test site lattitude respectively. If the azimuth and lattitude indications are in agreement with the known values for these parameters press VERB 33, ENTER on K148 and proceed to 6.2.19.7.

6.2.19.6 Insert and verify the following sequence into K148.

a. VERB 21 ENTER

b. X X X . X X (correct NB azimuth) ENTER

c. VERB 22 ENTER

d. X X X . X X (correct site latitude) ENTER

e. VERB 33 ENTER

6.2.19.7 Observe VERB 06, NOUN 66 flashing with Rows R1, R2, and R3 indicating:

R1 +00032

R2 +00000

R3 +00001

If the above indications are present on the CRT or DSKY insert VERB 33, ENTER into K148 and proceed to 6.2.19.9.

6.2.19.8 Insert and verify the following sequence into K148.

a.	VERB 21	NOUN 02	ENTER
b.	01231		ENTER
c.	+00032		ENTER
d.	VERB 21	NOUN 02	ENTER
e.	01232		ENTER
f.	+00000		ENTER
g.	VERB 21	NOUN 02	ENTER
h.	01223		ENTER
i.	+00001		ENTER
j.	VERB 33		ENTER

6.2.19.9 The G&N System will now cycle through the following modes as indicated on the IMU CONTROL Panel.

a. ZERO ENCODER
b. FINE ALIGN
c. ATT CONT
d. FINE ALIGN
e. COARS ALIGN
f. FINE ALIGN

6.2.19.10 Approximately 90 seconds after the final Fine Align mode is entered record indication of IG, MG and OG CDU's and the time.

6.2.19.11 After approximately 14 minutes, VERB 06, NOUN 66 will appear flashing. Record indication of the IG, MG and OG CDU's and the time. Record indication of R1 and R2.

NOTE: R1 should be ±00000.

6.2.19.12 To repeat test for positions 2 through 6 insert VERB 33 ENTER twice into K148 after performing 6.2.19.11 for each position except after position 6.

6.2.19.13 Insert and verify the following sequence into K148:

a.	VERB 33		ENTER
b.	Observe Verb 06,	NOUN 66	ENTER
c.	VERB 21	NOUN 02	ENTER
d.	01231		ENTER
e.	+00032		ENTER
f.	VERB 21	NOUN 02	ENTER
g.	01232		ENTER
h.	+00001		ENTER
j.	VERB 21	NOUN 02	ENTER
k.	01223		ENTER
l.	-00001		ENTER
m.	VERB 33		ENTER

NOTE: Approximately 90 seconds after the final entry into the **FINE** ALIGN mode (f below) perform 6.2.19.15.

6.2.19.14 The G&N System will now cycle through the following mode as indicated on the IMU CONTROL panel.

a. ZERO ENCODER
b. FINE ALIGN
c. ATT CONT
d. FINE ALIGN
e. COARS ALIGN
f. FINE ALIGN

6.2.19.15 Insert and verify the following sequence into K148:

a.	VERB 06	NOUN 20	ENTER

6.2.19.16 Record the indications of LEB DSKY rows R1, R2 and R3 and the time.

6.2.19.17 After approximately 14 minutes, VERB 06, NOUN 66 will appear flashing. Record indication of OG, IG and MG CDU's and the time. Record the indications of R1 and R2.

6.2.19.18 Repeat the test for positions 2 through 6 by inserting VERB 33 ENTER into K148 after 6.2.19.17 and then performing 6.2.19.13m through 6.2.19.17.

6.2.19.19 After performing position 6 terminate test by inserting VERB 34 ENTER into K148.

6.2.19.20 Insert and verify the following sequence into K148:

a. VERB 41, NOUN 20, ENTER

b. +00000 ENTER

c. +00000 ENTER

d. +00000 ENTER

6.2.19.21 The data recorded for positions 1 through 6 when performing 6.2.19.11 has the following meaning:

Position	Displayed Drift Coefficients
1	+NBDY
2	+NBDZ
3	+NBDX
4	+NBDY + ADSRAY
5	+NBDZ + ADSRAZ
6	+NBDX + ADSRAX

6.2.19.22 The data recorded for positions 1 through 6 when performing 6.2.19.16 and 6.2.19.17 shall be utilized on the calculations sheets to derive the ADIA terms.

6.2.19.23 The following terms shall be solved for and have the following tolerances with respect to the last performance of JDC 15236, 15237, 15239, 15240, 15242, 15243 found in the G&N System Data Package:

Δ NBD = ± 7 meru
Δ ADSRA = ± 12 meru
Δ ADIA = ± 20 meru

6,2.20 Fine Alignment Test

6.2.20.1 Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation hasnot been interrupted. If system operation has been interrupted, perform 6.2.2.2 Turn On Procedure.

6.2.20.2 Prior to performing this test, the G&N Installation Qualification Fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The azimuth supplied by the azimuth autoset (Ref. No. 1) shall be known to ± 30 minutes of arc.

> NOTE: G&N System shall have had OPERATE power applied for a minimum of one hour. System shall be in COARSE ALIGN mode under computer control with gimbal angles at zero. Insure that G&N OPTICS MNA and MNB breakers are on (pushed in).

6.2.20.3 Set OPTICS mode switch to ZERO OPTICS. After ZERO ENCODER lamp has extinguished onCondition Annunciator panel, return OPTICS mode switch to MANUAL.

6.2.20.4 Initiate the test by inserting the following into K148:

a. VERB 57 ENTER
b. Observe VERB 21, NOUN 01 flashing
c. 00003 ENTER
d. Observe PROGRAM lights, 07

6.2.20.5 Observe that the ZERO ENCODER lamps on Condition Annunciator and IMU CONTROL panel light and then extinguish.

6.2.20.6 Observe VERB 06, NOUN 61 flashing with the following display:

a. R1 + xxx.xx (45.000, + S/C AZ degrees)
b. R2 + 00000 (TGT 1 EL, degrees)
c. R3 00001 (TGT number)

If R1 and R2 are correct for present location insert VERB 33, ENTER into K148 and proceed to 6.2.20.9.

6.2.20.7 To correct R1, insert and verify the following into K148:

a. VERB 21 ENTER
b. + xxx.xx (45.000 + S/C AZ) ENTER

6.2.20.8 To correct R2, insert and verify the following into K148:

a. VERB 22 ENTER
b. + 00000 ENTER
c. VERB 33 ENTER

6.2.20.9 Observe VERB 06, NOUN 61 flashing with the following display:

a. R1 - xxx.xx (-45.000 + S/C AZ degrees)
b. R2 + 00000 (TGT 2 EL, degrees)
c. R3 00002 (TGT number)

If R1 and R2 are correct forpresent location insert VERB 33, ENTER into K148 and proceed to 6.2.20.12.

6.2.20.10 To correct R1, insert and verify the following into K148:

a. VERB 21 ENTER
b. + xxx.xx (-45.000 + S/C AZ) ENTER

6.2.20.11 To correct R2, insert and verify the following into K148:

a. VERB 22 ENTER
b. + 00000 ENTER
c. VERB 33 ENTER

6.2.20.12 Observe VERB 06, NOUN 61 flashing with the following display.

a. R1 + 13500 (SM A2)
b) R2 + 28516 (LAT)

If R1 and R2 are correct for present location, insert VERB 33, ENTER into K148 and proceed to 6.2.20.15.

6.2.20.13 To correct R1 insert and verify the following into K148:

a. VERB 21 ENTER
b. + 13500 (correct SM A2) ENTER

6.2.20.14 To correct R2 insert and verify the following into K148:

a. VERB 22 ENTER
b. + 28516 (correct LAT) ENTER
c. VERB 33 ENTER

6.2.20.15 Observe VERB 21, NOUN 30 flashing, insert and verify 00001, ENTER into K148.

6.2.20.16 Observe VERB 51 flashing with R1 indicating 00001. Sight through SXT and align with TGT 1. Upon reticle coincidence, press MARK pushbutton. If satisfied with alignment, press ENTER pushbutton on DSKY. (If not satisfied with alignment, insert and verify VERB 52, ENTER into DSKY and repeat above procedure.)

6.2.20.17 Observe VERB 51 flashing with R1 indicating 00002. Sight through SXT and align with TGT 1. Upon reticle coincidence, press MARK pushbutton. If satisfied with alignment, press ENTER pushbutton on DSKY. (If not satisfied with alignment, insert and verify VERB 52, ENTER into DSKY and repeat above procedure.)

6.2.20.18 During approximately the next 3.5 minutes the following IMU moding will occur as indicated on the IMU CONTROL panel.

a. ZERO ENCODE
b. FINE ALIGN
c. ATTITUDE CONTROL
d. FINE ALIGN
e. COARSE ALIGN
f. FINE ALIGN

6.2.20.19 Repeat 6.2.20.16 and 6.2.20.17.

6.2.20.20 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 60 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Y PIPA IA about the Z_{SM}. Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Z PIPA IA about the Y_{SM}. Record R1 and R2.

6.2.20.21 Insert and verify VERB 34, ENTER into K148.

6.2.20.22 Repeat 6.2.20.4 through 6.2.20.14.

NUMBER	REVISION LETTER	PAGE

6.2.20.23 Observe VERB 21, NOUN 30 flashing, insert and verify 00002, ENTER into K148.

6.2.20.24 Repeat 6.2.20.16 through 6.2.20.19.

6.2.20.25 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the X PIPA IA about the Z_{SM}. Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Y PIPA IA about X_{SM}. Record R1 and R2.

6.2.20.26 Insert and verify VERB 34, ENTER into K148.

6.2.20.27 Repeat 6.2.20.4 through 6.2.20.14.

6.2.20.28 Observe VERB 21, NOUN 30 flashing, insert and verify 00003, ENTER into K148.

6.2.20.29 Repeat 6.2.20.16 through 6.2.20.19.

6.2.20.30 Approximately 7 minutes after the IMU enters the FINE ALIGN mode, VERB 06, NOUN 66 will flash. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the X PIPA IA about Z_{SM}. Record and insert VERB 33, ENTER. R1 (whole) and R2 (fractional) will contain the misalignment (arc sec) of the Z PIPA IA about the X_{SM}. Record R1 and R2.

6.2.20.31 Insert and verify the following into K148:

a. VERB 34 ENTER
b. VERB 41 NOUN 20 ENTER
c. + 00000 ENTER
d. + 00000 ENTER
e. + 00000 ENTER

6.2.20.32 The misalignment angle of an IA about any SM axis shall be 150 arc seconds or less.

6.2.20.33 Remove OPTICS power by pulling out OPTICS MNA and MNB breakers on Right Hand Circuit Breaker panel.

6.2.21 Gyrocompassing Test

6.2.21.1 Proceed with this test if the Operate Power On Test 6.2.4 or the Turn On Procedure of 6.2.2.2. has been completed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.2.2. before proceeding.

6.2.21.2 Load the **Flt Rope Cont Sim Flt Tape.** **(F02C017 K00040-XX)** on the tape reader. This tape loads nominal IRIG and PIPA parameters for G&N 122 and also loads gyrocompassing azimuth, latitude and Nav. Base azimuth for testing in the MSCB. After display and verification of the data load, the tape will initiate the Prelaunch Alignment Program.

6.2.21.3 Apply G&N OPTICS power by pushing in OPTICS MNA and MNB breakers on Right Hand Circuit Breaker panel.

6.2.21.4 Start tape reader, after the tape reader stops, the data load may be changed by performing the following sequences.

6.2.21.4.1 If required to change the IRIG or PIPA data load:

a. Convert the data from engineering units to the AGC octal as stored in erasable memory.

b. Load the octal data into the AGC by inserting the following sequence into K148.

```
VERB    21      NOUN         02           ENTR
YYYYY   ENTR     (E-Memory address from Table XXIII)
XXXXX   ENTR     (OCTAL data)
```

6.2.21.4.2 If required to change the gyrocompassing azimuth data load:

a. Perform the following calculation:

$$\frac{\text{Gyrocompassing Azimuth}}{360} \text{ X } 16384 = \text{AAAA.BBBBB}$$

b. Load correction into AGC by inserting the following sequence into K148:

```
VERB 21         NOUN 02             ENTR
01316           ENTR
SOAAAA          ENTR                (S = sign)
VERB 21         NOUN 01             ENTR
01317           ENTR
SBBBBB          ENTR
```

IMU Compensation Term	E-Memory Location
NBDX	0744
NBDY	0745
NBDZ	0746
ADIAX	0747
ADIAY	0750
ADIAZ	0751
ADSRAX	0752
ADSRAY	0753
ADSRAZ	0754
PIPAX BIAS	0736
PIPA S. F	0737
PIPA Y BIAS	0740
PIPA Y S. F	0741
PIPA Z BIAS	0742
PIPA Z S. F	0743

Table XXIII IMU Compensation Terms

6.2.21.4.3 If required to change the nav. base azimuth data load:

a. Perform the following calculation:

$$\frac{\text{Nav. Base Azimuth}}{360} \text{ X } 16384 = \text{EEEE.FFFFF}$$

b. Load correction into AGC by inserting the following sequence into K148:

```
VERB 21       NOUN 02       ENTR
01352         ENTR
SCEEEE        ENTR          (S = sign)
VERB 21       NOUN 01       (ENTR)
01353         ENTR
SFFFFF        ENTR
```

6.2.21.4.4 If required to change the latitude data load:

a. Perform the following claculation:

$$\frac{\text{latitude}}{360} \text{ X } 16384 = \text{MMMM.NNNNN}$$

b. Load correction into AGC by inserting the following sequence into K148:

```
VERB 21       NOUN 02       ENTR
01314         ENTR
SOMMMM        ENTR
VERB 21       NOUN 01       ENTR
01315         ENTR
SNNNNN        ENTR
```

6.2.21.5 Start the tape reader.

6.2.21.5.1 When the tape reader stops, observe VERB 06, NOUN 61 flashing with R1 displaying gyrocompassing azimuth +77.99 degrees within ± 0.01 degrees.

6.2.21.6 Start the tape reader.

6.2.21.6.1 When the tape reader stops, observe VERB 06, NOUN 61 flashing with R1 displaying Nav. Base azimuth, +165.00 within 0.01 degrees and R2 displaying local latitude, +28.516 within 0.006 degrees.

6.2.21.7 Start the tape reader to initiate the Initialization and Inertial Reference portions of the Prelaunch alignment Program. Major Mode will indicate 01.

6.2.21.8 Within 10 minutes the MAJOR MODE lights will indicate 02 on the CRT and DSKY when the program enters the gyrocompass portion of the PRE-LAUNCH ALIGNMENT program. At this time, and during each succeeding 15 minute interval for the duration of the test, record in Table 6.1 the dial readings for the Outer Gimbal, Inner Gimbal and Middle Gimbal CDU's. After recording the first (t=0) set of data immediately proceed to step 6.2.21.9.

6.2.21.9 Set the CONTROLLER MODE switch to DIRECT, OPTICS MODE switch to ZERO OPTICS, and CONTROLLER SPEED switch to MED on the G&N Indicator Control Panel.

6.2.21.10 After the ZERO ENCODER lamp on Event Module 4A3-A4-E1-7 extinguishes set the Optics Mode switch to MANUAL.

6.2.21.11 Enter the following inputs into K148:

```
VERB 37, ENTR
     03, ENTR
```

NOTE: The 03 will appear in the NOUN lights when entered. Following the pressing of the ENTR pushbutton, the NOUN lights will be blanked. When the test is entered, 03 will appear in the MAJOR MODE lights within 10 seconds and the KEY RELEASE lamp on the DSKY will illuminate.

6.2.21.12 Observe that the Major Mode lights indicate 03 on the CRT.

6.2.21.13 Press the KEY RELEASE Pushbutton on the LEB DSKY.

6.2.21.14 Perform paragraphs 6.2.20.6 through 6.2.20.11 of the G&N FINE ALIGNMENT TEST, to enter the correct components for TARGETS 1 and 2.

6.2.21.15 Observe that the "MARK" command, VERB 51 is flashing on the CRT and DSKY and that the following values are displayed in R1, R2 and R3.

R1	+ 00001	(Target #1)
R2	+ 00002	(Target #2)
R3	+ 00000	

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6.2.21.16 Align the SXT StLOS with the reticle dot on Target #1. When aligned, press the MARK pushbutton.

6.2.21.16.1 If not satisfied with the MARK, enter VERB 52 into K148 or LEB DSKY. Press ENTR pushbutton and repeat step 6.2.21.16. If satisfied with the "MARK" proceed to 6.2.21.17. Observe that VERB 51 continues to flash on CRT and DSKY.

6.2.21.17 Align the SXT StLOS with the reticle dot on Target #2. When aligned, press the MARK pushbutton. Observe 50 in the VERB lights on the CRT and DSKY requesting operator action.

6.2.21.17.1 If not satisfied with this "MARK" reject it by entering VERB 52 into K148 or LEB DSKY. Press ENTR pushbutton and repeat step 6.2.21.17. If satisfied with the "MARK", press the ENTR pushbutton and proceed to 6.2.21.18.

6.2.21.18 Observe the following displays on the CRT and LEB DSKY: (R1, R2 and R3 contain the three misalignment angles).

VERB 06, NOUN 67 (FLASHING)
R1 ± XX.XXX (X Gyro Torquing Angle)
R2 ± XX.XXX (Y Gyro Torquing Angle)
R3 ± XX.XXX (Z Gyro Torquing Angle)

6.2.21.19 Enter the following into K148:

VERB 21	ENTR 00000	X set torq ∠ to 0
VERB 22	ENTR 00000	Y set torq ∠ to 0
VERB 33	ENTR	

6.2.21.20 Observe and verify that the MAJOR MODE lights indicate 02 on the CRT and DSKY.

6.2.21.20.1 Wait two (2) hours before proceeding.

6.2.21.21 Repeat steps 6.2.21.9 through 6.2.21.18. Record the readings for the appropriate gyros in Table 6.2. (First Reading, Data Set #2).

6.2.21.21.1 Enter the following inputs into K148:

VERB 34 ENTR

6.2.21.22 Repeat steps 6.2.21.9 and 6.2.21.18 two (2) more times to obtain the second and third readings. Each time that 6.2.21.18 is completed, record the readings for the appropriate gyros in Table 6.2, and enter the following into K148:

VERB 34 ENTR

6.2.21.22.1 Calculate the average value of the three readings for each gyro and record in Table 6.2.

6.2.21.23 At 30 minute intervals perform steps 6.2.21.23.1 through 6.2.21.23.3 three times to obtain data sets 3 and 4.

6.2.21.23.1 Repeat steps 6.2.21.9 through 6.2.21.18.

6.2.21.23.2 Record the contents of R1, R2 and R3 for the appropriate gyros in Table 6.2.

6.2.21.23.3 Enter the following into K148:

VERB 34 ENTR

6.2.21.24 Calculate the average value of the three readings for each gyro in each data set. Record in Table 6.2.

6.2.21.24.1 The average values recorded in Table 6.2, data sets 2, 3 and 4 shall be:

± 0.05 degrees or less on X
± 0.05 degrees or less on Y
± 0.60 degrees or less on Z

6.2.21.24.2 The average values for data sets 3 and 4 shall not deviate from the average value for data set 2 by more than the following amounts:

± 0.02 degrees or less than X
± 0.02 degrees or less than Y
± 0.08 degrees or less than Z

NOTE: Coordinate the next steps with the test conductor before proceeding.

6.2.21.25 After recording data set 4, have the input voltage to the G&N system adjusted to 26.1 volts dc for a period of one hour.

6.2.21.25.1 The following lamps on Event Module 4A3A5E1 shall be lighted:

SIGNAL

a. 28 V DC AGC
b. 28 V DC OPERATE/IMU
c. 28V DC OPTICS

6.2.21.25.2 Record voltage readings on the CRT of the following signals on the data sheet:

	Measurement List No.	Signal	Requirement
a.	CG 1400	IMU 2.5 V 25.6 KC Supply	2.1 to 2.9 VRMS
b.	CG 1401	OPT 2.5 V 25.6 KC Supply	2.1 to 2.9 VRMS
c.	CG 1301	IMU 2 V 3200 CPS Supply	2.9 to 4.10 VRMS
d.	CG 1101	-28 VDC ELECTRONIC	-33.7 to -21.3 VDC
e.	CG 1030	+3 VDC AGC Supply	+1.88 to 4.12 VDC
f.	CG 1020	+13 VDC AGC Supply	+11.7 to +14.3 VDC
g.	CG 1201	IMU 28 V 800 CPS 1% 0°	27.0 to 29.9 VRMS
h.	CG 1203	IMU 28 V 800 CPS 5% 0°	24.7 to 30.3 VRMS
i.	CG 1202	IMU 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS
j.	CG 1204	CDU 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS
k.	CG 1211	OPT 28 V 800 CPS 1% 0°	27 to 29 VRMS
l.	CG 1212	OPT 28 V 800 CPS 5% -90°	26.1 to 29.9 VRMS

6.2.21.25.3 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times thirty minutes after adjustment of the G&N input voltage to 26.1 volts dc.

6.2.21.25.4 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times one hour after adjustment of the G&N input voltage to 26.1 volts dc. Record the data as data set 6 in Table 6.2 and calculate and record the average values.

6.2.21.26 Have the input voltage to the G&N system adjusted to 31.3 volts dc for a period of one hour.

6.2.21.26.1 The following lamps on Event Module 4A3A5E1 shall be lighted:

SIGNAL

a. 28 V DC AGC
b. 28 V DC OPERATE IMU
c. 28 V DC OPTICS

6.2.21.26.2 Record the voltage readings for the signals listed in 6.2.21.25.2. The requirements shall be those listed in 6.2.21.25.2.

6.2.21.26.3 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times thirty minutes after adjustment of the G&N input voltage to 31.3 volts dc. Record the data as data set 7 in Table 6.2 and record the average values.

6.2.21.26.4 Repeat steps 6.2.21.23.1 through 6.2.21.23.3 three times one hour after adjustment of the G&N input voltage to 31.3 volts dc. Record the data as data set 8 in Table 6.2 and calculate and record the average values.

6.2.21.27 Have the input voltage to the G&N system adjusted to 28 volts dc.

6.2.21.28 Enter the following into the K148:

```
VERB 37      ENTR
 00          ENTR
VERB 40      NOUN 20     ENTR wait 90 seconds
VERB 41      NOUN 20     ENTR
+00000       ENTR
+00000       ENTR
+00000       ENTR
```

6.2.21.29 Verify that COARSE ALIGN is the only mode lamp lighted on the IMU Control Panel.

6.2.21.30 Pull out OPTICS MNA and MNB breakers on Right Hand Circuit Breaker panel.

TABLE 6.1

Time	CDU Dial Readings		
Minutes	OG	IG	MG
0			
15			
30			
45			
60			
75			
90			
105			
120			
135			
150			
165			
180			
195			
210			
225			
240			
255			
270			
285			
300			

TABLE 6.2

Data Set	X Gyro Torquing Angle (R1)				Y Gyro Torquing Angle (R2)				Z Gyro Torquing Angle (R3)			
	First Reading	Second Reading	Third Reading	Average	First Reading	Second Reading	Third Reading	Average	First Reading	Second Reading	Third Reading	Average
1												
2 (2 hours)												
3 (2.5 hours)												
4 (3.0 hours)												
5 (lo Bus)												
6 (Lo Bus)												
7 (Hi Bus)												
8 (Hi Bus)												

NUMBER	REVISION LETTER	PAGE

ADDENDUM NO. 1

This specification (ND 1002326) shall be modified as shown below for use with Spacecraft 020.'

1. Page 3, Change from: "MA 0308-0047 Component Installation Procedure - Apollo Guidance Equipment S/C 017."
   To: "MA 0308-0047 Component Installation Procedure-Apollo Guidance Equipment S/C 020."

2. Page 4, Change from: "SC 017, Block I, Series 100, Acceptance Data Package."
   to: "SC 020 Block I Series 100, Acceptance Data Package."

3. Page 6, Paragraph 4.1, Item 20
   Change from: "F02C017-K00012-XX"
   to: "F02C020-K00012-XX"

4. Page 9 , paragraph 5.7.2
   Change from: ".......specification MA 0308-0047 Mechanical Installation Specification for Apollo Guidance Equipment (S/C 017)."
   to: ".......specification MA 0308-0047 Mechanical Installation Specification for Apollo Guidance Equipment (S/C 020)."

   Item 35
   Change from: "F02C017-K00020-XX"
   to: "F02C020-K00020-XX"

   Item 36
   Change from: "F02C017-K00031-XX"
   to: "F02C020-K00031-XX"

   Item 37
   Change from: "F02C017-K00040-XX"
   to: "F02C020-K00040-XX"

5. Page 20, Paragraph 6.2.1.3.11
   Change from: "F02C017-K00012-XX"
   to: "F02C020-K00012-XX"

6. Page 27, Paragraph 6.2.2.2.13 and 6.2.2.2.14
   Change from: "F02C017-K00012-XX"
   to: "F02C020-K00012-XX."

7. Page 32, Paragraph 6.2.3.3.1
   Change from: "F02C017-K00020-XX"
   to: "F02C020-K00020-XX"

8. Page 75, Paragraph 6.2.15.1
   Change from: "F02C017-K00031-XX"
   to: "F02C020-K00031-XX"

9. Page 97, Paragraph 6.2.21.2
   Change from: "F02C017-K00040-XX"
   to: "F02C020-K00040-XX."

APOLLO G&N Specification
ND1002337 REV A
Original Issue Date: 7/6/66
Release Authority: TDRR 30130
Class A Release

APOLLO G&N ENVIRONMENTAL QUALIFICATION SPECIFICATION FOR BLOCK II AND LEM EQUIPMENT

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
1/5/67	A	32483	1-60 Was 60 pages; now	MGM EA	WLS
			43 pages. RDG/AC		

This specification consists of page 1 to 43 inclusive.

APPROVALS	NASA/MSC	J. Kent 7/5/66	W.S.Stameris 7/5/66 MIT/IL	M.G.Murley 7/6/66	AC RDG

1. SCOPE

1.1 GENERAL. It is the purpose of this document to establish the requirements and tests for demonstrating the qualification status of the LEM and Block II Guidance and Navigation System design and production for the earth orbital and ultimate lunar rendezvous-landing mission, and shows the degree of testing which must be satisfactorily accomplished.

1.2 ENVIRONMENTAL CONDITIONS. The environmental conditions and stress levels given bear a direct relationship to specifications describing spacecraft conditions. Varying equipment locations and mounting provisions have been taken into consideration. Transportation, handling, and storage conditions occurring during the normal life cycle of the equipment have been utilized to modify the tests appropriately either by adjustment of stress level or duration of application in order to optimize the simulation. The profiles within this specification encompass these nonflight conditions but are identified by the maximum level of each environmental exposure. Combinations of environments have been specified where facility considerations permit. Combinations of environments have also been used to qualify test equipment common to LEM and Block II.

1.3 QUALIFICATION CRITERIA. The qualification of the Block II and LEM Apollo Guidance and Navigation equipment shall be accomplished by subjecting each unit to the applicable tests specified herein. Full qualification status is subject to completion of the specified tests and resolution of all failures.

1.4 TEST PLANS AND PROCEDURES. Detailed test plans shall be prepared by the responsible contractor for each item subjected to qualification testing. The detailed test plan shall be submitted to MIT/IL and NASA/MSC for approval at least 30 days prior to the scheduled start of the test. After approval of a test plan, necessary revisions shall be supplied to MIT/IL and NASA/MSC in a timely manner.

1.5 EQUIPMENT CONFIGURATION. The LEM and Block II equipment qualified shall consist of the following. See Table VI for test requirements and equipment to be tested.

1.5.1 LEM Equipment

a. Inertial Measurement Unit (IMU)
b. LEM Navigation Base (NVB)
c. Alignment Optical Telescope (AOT)
d. Computer Control and Retical Dimmer (CCRD)
e. Power and Servo Assembly (LEM) (PSA)
f. Signal Conditioner Assembly (SCA)
g. Pulse Torque Assembly (PTA)
h. LEM Guidance Computer (LGC)
i. Electronic Coupling Data Unit (ECDU)
j. Display and Keyboard (DSKY)
k. A and B Harnesses

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j. Display and Keyboard (DSKY)
k. A and B Harnesses

1.5.2 Block II Equipment

a. Inertial Measurement Unit (IMU)
b. Block II Navigation Base (NVB)
c. Power and Servo Assembly (Block II) (PSA)
d. Signal Conditioner (SC)
e. PIPA Electronics Assembly (PEA)
f. Command Module Guidance Computer (CMC)
g. Electronic Coupling Data Unit (ECDU)
h. Display and Keyboard (DSKY)
i. Eyepiece Stowage Compartment (ESC)
j. Optical Unit Assembly (OUA)
k. Optics Shroud Assembly
m. Bellows
n. G&N Interconnection Harness
o. Hose Assembly
p. Display and Controls (D&C)

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents of the issue in effect on the date of invitation for bids form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-I-26600	Interface Control Requirements Aeronautical Equipment (Military)

NASA

MSC-ASPO-EM-10A	Addendum to MIL-I-26600

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Control Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment

STANDARDS

Military

MIL-STD-810	Environmental Test Methods for Aerospace Ground Equipment

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DRAWINGS

NAA

ICD MH01-01348-416	Guidance and Navigation and Control Subsystem Environments
ICD MH01-01349-416	Guidance and Navigation (G&N)Thermal Requirements for Block II APOLLO Guidance Equipment (AGE)

Grumman Aircraft Engineering Corporation

ICD LIS-510-10001	Thermodynamic Requirements for Guidance and Navigation
ICD LIS-520-10001	LEM Design Environment

(Copies of specifications, standards, drawings, bulletins, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 CONFLICTING REQUIREMENTS. In the event of a conflict between requirements, the following order of precedence shall apply. The contractor shall also notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 GENERAL. The environmental requirements of this section are indicative of the operational, transportation, handling, and storage environments for the airborne Apollo equipment components. They are extracted from the applicable ICD's and are given here for reference only.

3.2 FACTORY-TO-USE POINT ENVIRONMENTS. These requirements shall apply, unless otherwise specified, under the requirements for the particular equipment component.

3.2.1 Transportation, Handling and Storage. The following represent the environmental extremes which may be encountered by the equipment in a nonoperating condition during transportation, handling, and storage. The equipment may be protected by suitable packaging for transportation and storage if these environments exceed the design operating requirements. The equipment shall be capable of meeting the operating performance requirements of its performance specification after exposure to these environments while protected by its normal packaging:

3.2.1.1 Natural Environments, Block II (Reference ICD MH01-01348-416). The natural environments to which the equipment may be exposed while protected by its normal packaging shall be as follows:

a. Air Temperature

   (1) Air Transportation: -45°F. to +140°F. for 8 hours
   (2) Ground Transportation: -20°F. to +145°F. for 2 weeks
   (3) Storage: +25°F. to 105°F. for 3 years

b. Pressure

   (1) Air Transportation: 3.47 psia minimum (35,000 feet altitude) for 8 hours.

   (2) Ground Transportation and Storage: 11.78 psia minimum (6,000 feet altitude) for 3 years.

c. Humidity. 0 to 100 percent relative humidity, including conditions wherein condensation takes place in the form of water or frost, for at least 30 days.

d. Sunshine. Solar radiation of 360 BTU/sq.ft/hr. for 6 hours per day for 2 weeks.

e. Rain. 0.6 in/hr maximum for 12 hours, 2.5 in/hr for 1 hour.

f. Salt Spray. Salt atmosphere as encountered in coastal areas, the effect of which is simulated by exposure to a 5 percent salt solution by weight for 48 hours.

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e. Rain. 0.6 in/hr maximum for 12 hours, 2.5 in/hr for 1 hour.

f. Salt Spray. Salt atmosphere as encountered in coastal areas, the effect of which is simulated by exposure to a 5 percent salt solution by weight for 48 hours.

3.2.1.2 Natural Environments, Block II Transportation in Command Module (Reference ICD MH01-01348-416.) The following conditions apply to the CM interior during aircraft transportation, subsequent to GN&C installation:

a. Temperature: -20°F. minimum to 110° F. maximum
b. Pressure: 9.47 psia
c. Humidity: <35% Relative Humidity

3.2.1.3 Induced Environments, Block II (Reference ICD MH01-01348-416. The induced environments to which the equipment may be exposed while protected by its normal packaging shall be as follows:

a. **Shock.** The design shock levels applicable to protective packaging shall be those resulting from free-fall drop in accordance with Table I. The protective packaging shall attenuate shock such that packaged equipment shall not be exposed to shock levels exceeding the equipment design operating requirements.

TABLE I

PACKAGING SHOCK

WEIGHT*1 (Pounds)	DIMENSIONS*2 (inches, max)	DROP HEIGHT (inches)		
		Free Fall	Edgewise	Cornerwise
<50	36	30	-	-
50 to 100	48	21	-	-
100 to 150	60	18	-	-
150 to 200	60	16	-	-
200 to 600	72	--	36	36

*[1] Weight of equipment and package or containers.
*[2] Dimension along any edge or diameter.

b. **Vibration.** Vibration shall be sinusoidal in any direction with the frequency and amplitude specified in Table II.

TABLE II

VIBRATION

WEIGHT* (pounds)	5.0 to 26.5 cps	26.5 to 52.0 cps (inch DA)	52.0 to 500.0 cps
<50	±1.56g	0.048	±6.0g
50 to 300	±1.30g	0.036	±5.0g

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50 to 300	±1.30g	0.036	±5.0g

*Weight of equipment and package or containers.

3.2.2 Use Point Prelaunch Environments

3.2.2.1 Induced, Block II (Reference ICD MH01-01348-416). These requirements represent the induced environmental design criteria for the equipment both in operating and nonoperating conditions. These induced environments are entirely controlled.

a. Temperature

(1) +60°F to 80° F for up to 3 years
(2) +52°F to 105°F for 1 hour maximum

b. Humidity. 30 to 70 percent for up to 3 years

c. Oxygen Atmosphere. 95±5 percent by weight oxygen at total pressures up to 14.7 psia for up to 24 hours. Oxygen partial pressure up to 14.7 psia coincident with total pressure up to 21.0 psia for 2 hours.

3.3 FLIGHT ENVIRONMENTS. The environmental conditions specified herein are applicable to the LEM and Block II equipment, and apply to the mission phases specified in Table III. In any mission phase, various combinations of environments specified in Table III can occur simultaneously with the exception of shock and acceleration.

TABLE III

FLIGHT ENVIRONMENTS

Environment	Launch & Boost	Launch Abort	Translunar Space	Lunar Descent	Lunar Ascent	Entry
Acceleration	3.3.1.a	3.3.1.h	3.3.1.b	3.3.1.c	3.3.1.d	3.3.1.g
Shock	- - -	- - -	3.3.2.a	3.3.2.b	3.3.2.c	3.3.2.d
Vibration	3.3.3.a	3.3.3.e	3.3.3.b	3.3.3.c	3.3.3.c	3.3.3.d
Pressure	3.3.4.a	- - -	3.3.4.b	3.3.4.c	3.3.4.c	3.3.4.c & f
Humidity	3.3.5	3.3.5	3.3.5	3.3.5	3.3.5	3.3.5
Temperature	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4
Corrosive Contaminants	3.3.7	3.3.7	3.3.7	3.3.7	3.3.7	3.3.7
EMI	3.3.8	3.3.8	3.3.8	3.3.8	3.3.8	3.3.8

3.3.1 Acceleration. The following accelerations are applicable for the mission phases of Table III. The LEM X, Y and Z reference axes shall be as defined by Figure 1 and Block II as defined by Figure 2.

3.2.2 Use Point Prelaunch Environments

3.2.2.1 Induced, Block II (Reference ICD MH01-01348-416). These requirements represent the induced environmental design criteria for the equipment both in operating and nonoperating conditions. These induced environments are entirely controlled.

a. Temperature

(1) +60°F to 80° F for up to 3 years
(2) +52°F to 105°F for 1 hour maximum

b. Humidity. 30 to 70 percent for up to 3 years

c. Oxygen Atmosphere. 95±5 percent by weight oxygen at total pressures up to 14.7 psia for up to 24 hours. Oxygen partial pressure up to 14.7 psia coincident with total pressure up to 21.0 psia for 2 hours.

3.3 FLIGHT ENVIRONMENTS. The environmental conditions specified herein are applicable to the LEM and Block II equipment, and apply to the mission phases specified in Table III. In any mission phase, various combinations of environments specified in Table III can occur simultaneously with the exception of shock and acceleration.

TABLE III

FLIGHT ENVIRONMENTS

Environment	Launch & Boost	Launch Abort	Translunar Space	Lunar Descent	Lunar Ascent	Entry
Acceleration	3.3.1.a	3.3.1.h	3.3.1.b	3.3.1.c	3.3.1.d	3.3.1.g
Shock	- - -	- - -	3.3.2.a	3.3.2.b	3.3.2.c	3.3.2.d
Vibration	3.3.3.a	3.3.3.e	3.3.3.b	3.3.3.c	3.3.3.c	3.3.3.d
Pressure	3.3.4.a	- - -	3.3.4.b	3.3.4.c	3.3.4.c	3.3.4.c & f
Humidity	3.3.5	3.3.5	3.3.5	3.3.5	3.3.5	3.3.5
Temperature	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4	3.3.6.1.6 3.3.6.2.4
Corrosive Contaminants	3.3.7	3.3.7	3.3.7	3.3.7	3.3.7	3.3.7
EMI	3.3.8	3.3.8	3.3.8	3.3.8	3.3.8	3.3.8

3.3.1 Acceleration. The following accelerations are applicable for the mission phases of Table III. The LEM X, Y and Z reference axes shall be as defined by Figure 1 and Block II as defined by Figure 2.

a. Launch and Boost (Reference ICD MH01-01348-416 and ICD LIS-520-10001

LEM X Axis: +4.9, -1.7g
LEM Y Axis: ±0.40g
LEM Z Axis: ±0.40g

Envelope of maximum values. See Figure 3 for time history

Block II X Axis: 6.0g

b. Translunar Space

X Axis: (-0.36g LEM) (+0.36g Block II)
Y Axis: ±0.062g
Z Axis: ±0.062g

Assume constant for duration of 6 minutes for translational acceleration

c. Lunar Descent, LEM

X Axis: +0.82g
Y Axis: ±0.08g
Z Axis: ±0.08g

Assume constant for duration of 6 minutes for translational accelerations

d. Lunar Ascent, LEM

X Axis: +0.70g
Y Axis: ±0.04g
Z Axis: ±0.04g

Assume constant for duration of 6 minutes for translational accelerations

e. Zero g Condition, LEM and Block II. No rotational or translational acceleration about any axis.

f. Lunar Stay, LEM. One-sixth g condition, vehicle at rest on lunar surface.

g. Entry, Block II. X Axis: +20g 30 second duration

h. Launch Abort, Block II. X Axis: +20g 10 seconds duration

3.3.2 Shock (Reference ICD MH01-01348-416 and ICD LIS-520-10001. The following shock magnitudes are applicable for the mission phases specified in Table III. The shocks shall be applied at the center of gravity of any item or equipment.

a. Translunar Space, LEM

X Axis: -0.052g
Y Axis: +0.065g
Z Axis: ±0.065g

Preliminary. Time history to be supplied when available

a. Launch and Boost (Reference ICD MH01-01348-416 and ICD LIS-520-10001

LEM X Axis: +4.9, -1.7g
LEM Y Axis: ±0.40g
LEM Z Axis: ±0.40g

Envelope of maximum values.
See Figure 3 for time history

Block II X Axis: 6.0g

b. Translunar Space

X Axis: (-0.36g LEM) (+0.36g Block II)
Y Axis: ±0.062g
Z Axis: ±0.062g

Assume constant for duration of 6 minutes for translational acceleration

c. Lunar Descent, LEM

X Axis: +0.82g
Y Axis: ±0.08g
Z Axis: ±0.08g

Assume constant for duration of 6 minutes for translational accelerations

d. Lunar Ascent, LEM

X Axis: +0.70g
Y Axis: ±0.04g
Z Axis: ±0.04g

Assume constant for duration of 6 minutes for translational accelerations

e. Zero g Condition, LEM and Block II. No rotational or translational acceleration about any axis.

f. Lunar Stay, LEM. One-sixth g condition, vehicle at rest on lunar surface.

g. Entry, Block II. X Axis: +20g 30 second duration

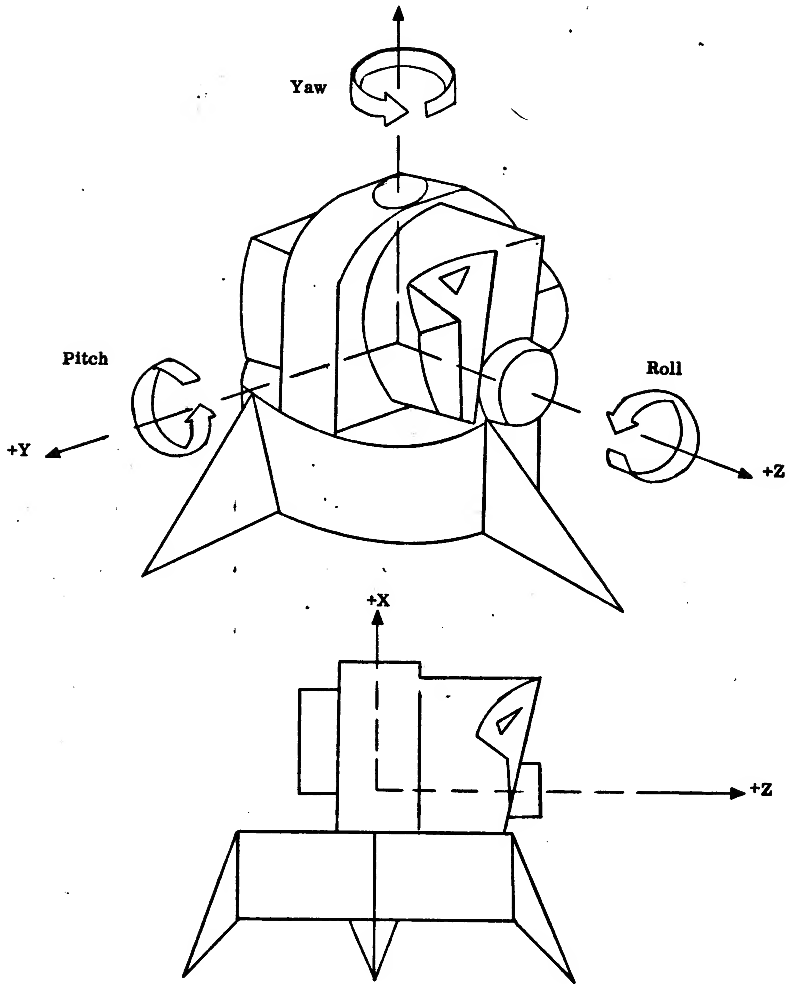
h. Launch Abort, Block II. X Axis: +20g 10 seconds duration

3.3.2 Shock (Reference ICD MH01-01348-416 and ICD LIS-520-10001. The following shock magnitudes are applicable for the mission phases specified in Table III. The shocks shall be applied at the center of gravity of any item or equipment.

a. Translunar Space, LEM

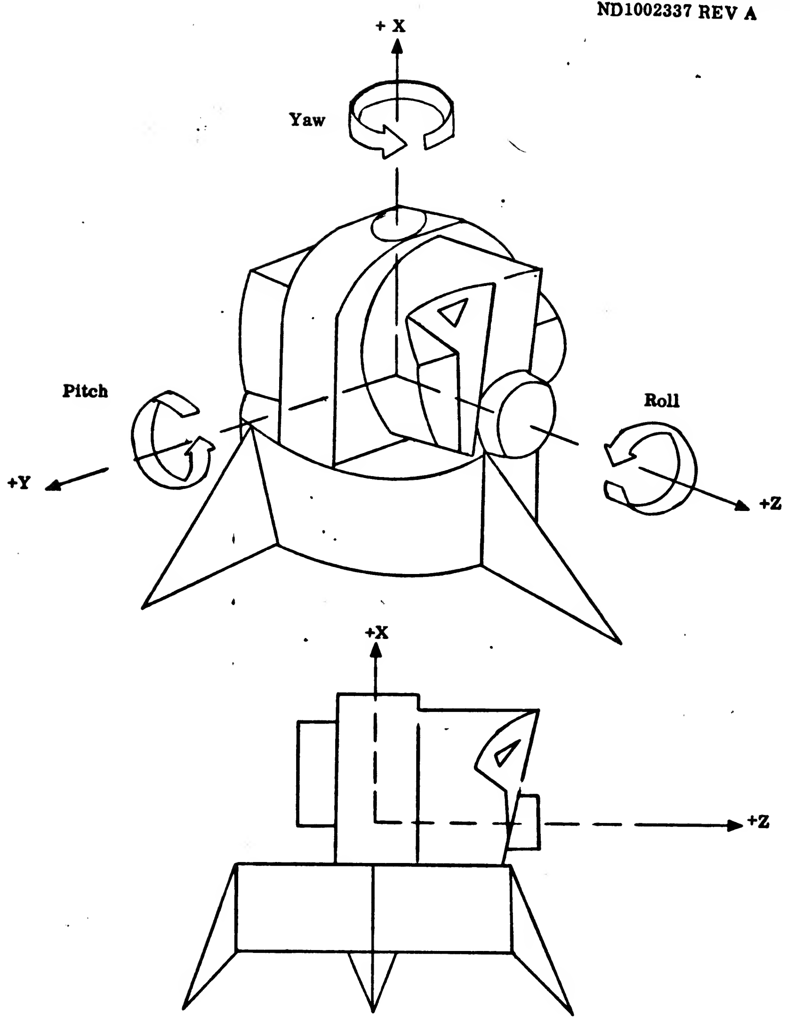
X Axis: -0.052g
Y Axis: +0.065g
Z Axis: ±0.065g

Preliminary. Time history to be supplied when available



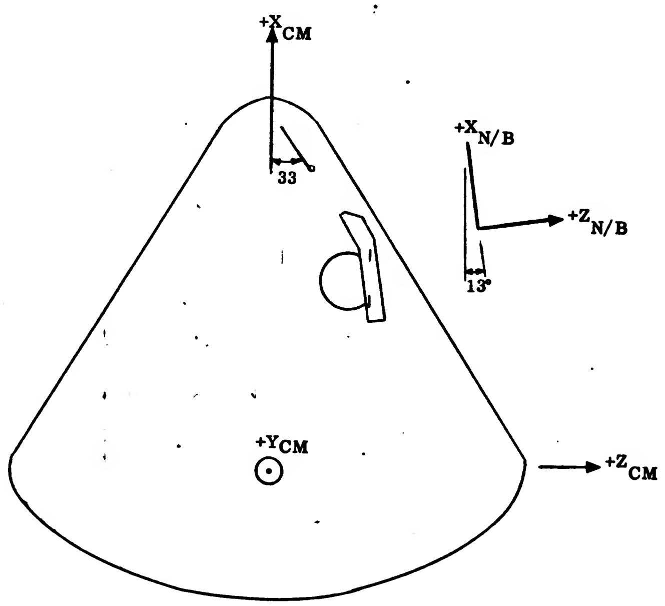
LEM REFERENCE AXES

FIGURE 1



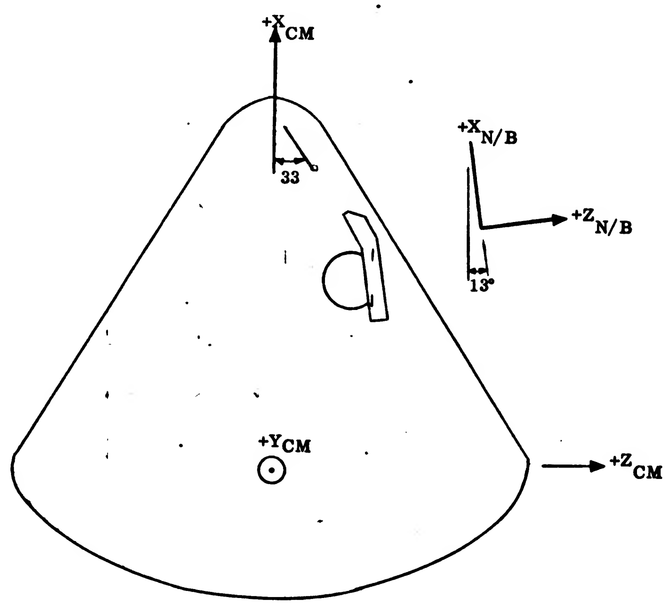
LEM REFERENCE AXES

FIGURE 1



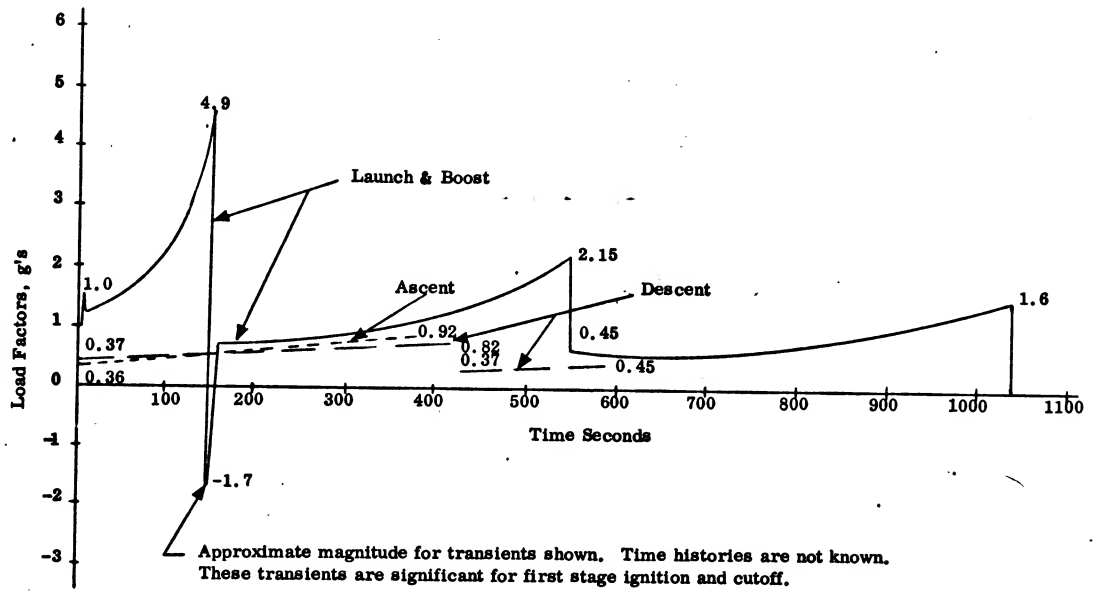
CM REFERENCE AXES

FIGURE 2



CM REFERENCE AXES

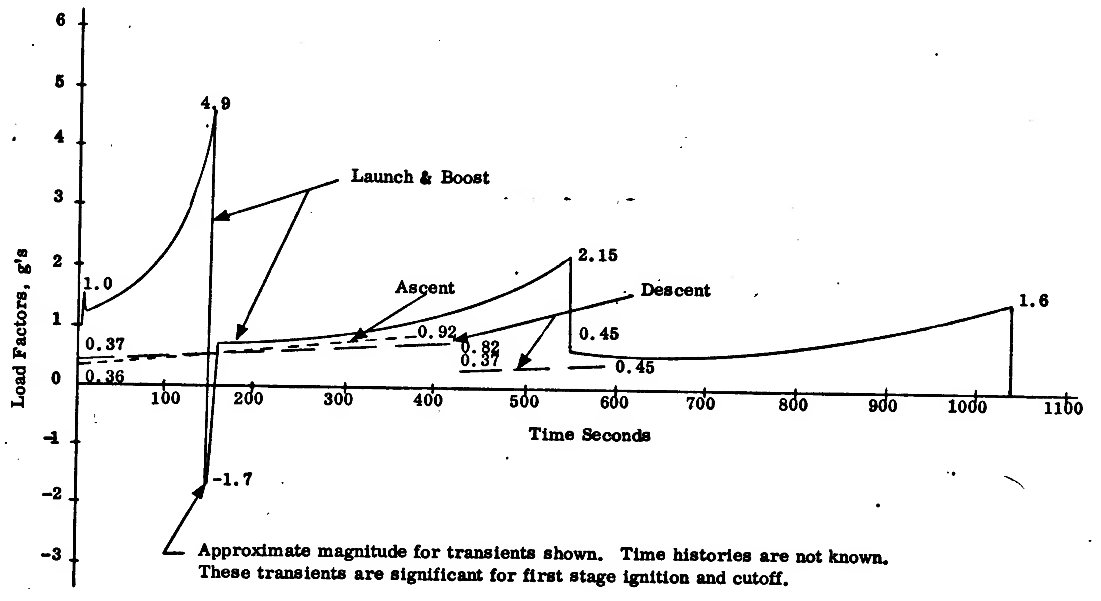
FIGURE 2



Approximate magnitude for transients shown. Time histories are not known. These transients are significant for first stage ignition and cutoff.

ACCELERATION TIME HISTORY

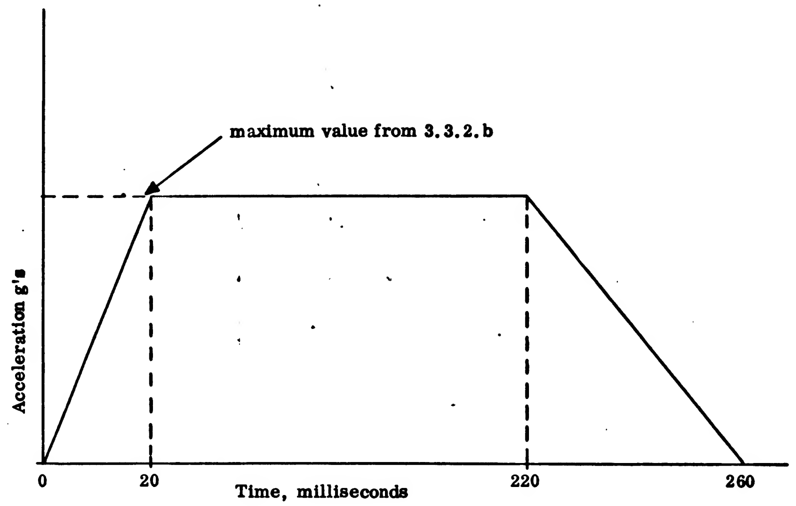
FIGURE 3



Approximate magnitude for transients shown. Time histories are not known. These transients are significant for first stage ignition and cutoff.

ACCELERATION TIME HISTORY

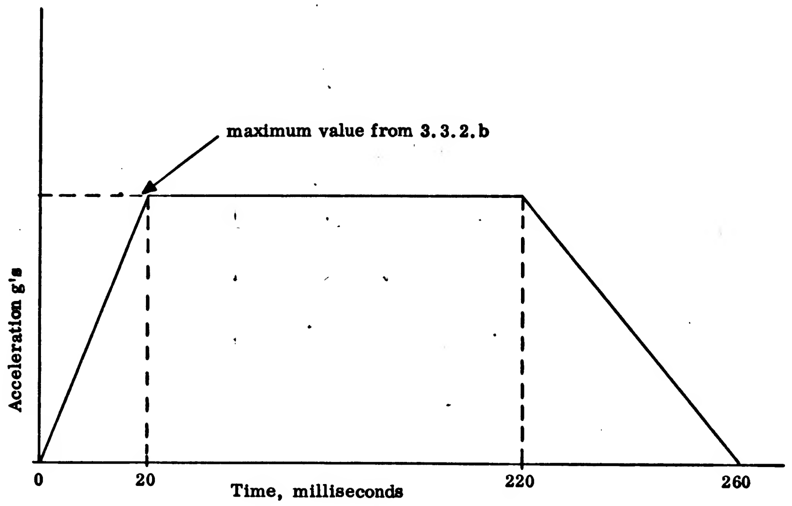
FIGURE 3



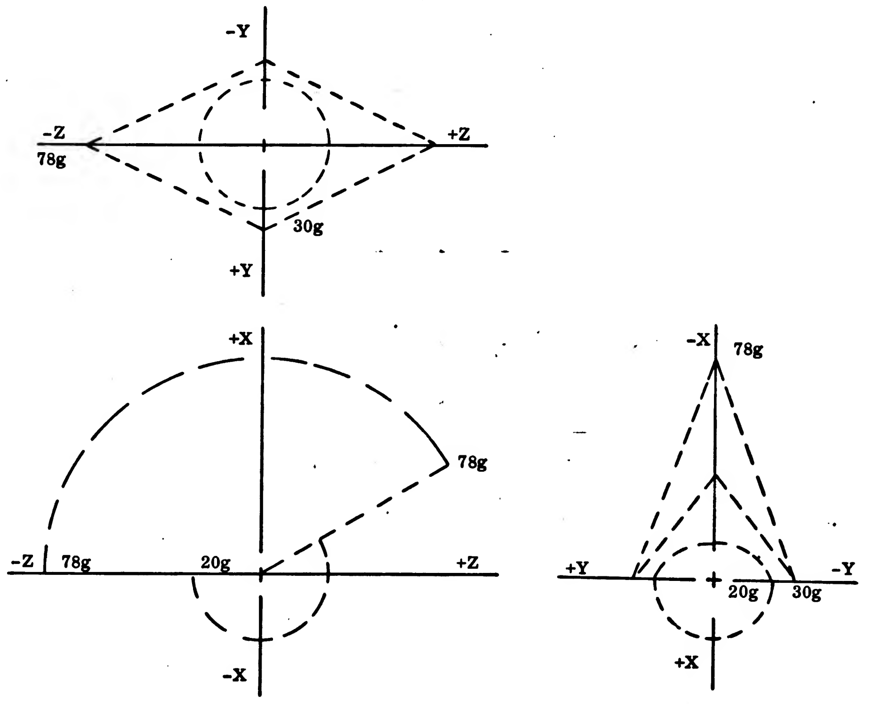
LUNAR LANDING

SHOCK MAGNITUDE TIME HISTORY

FIGURE 4

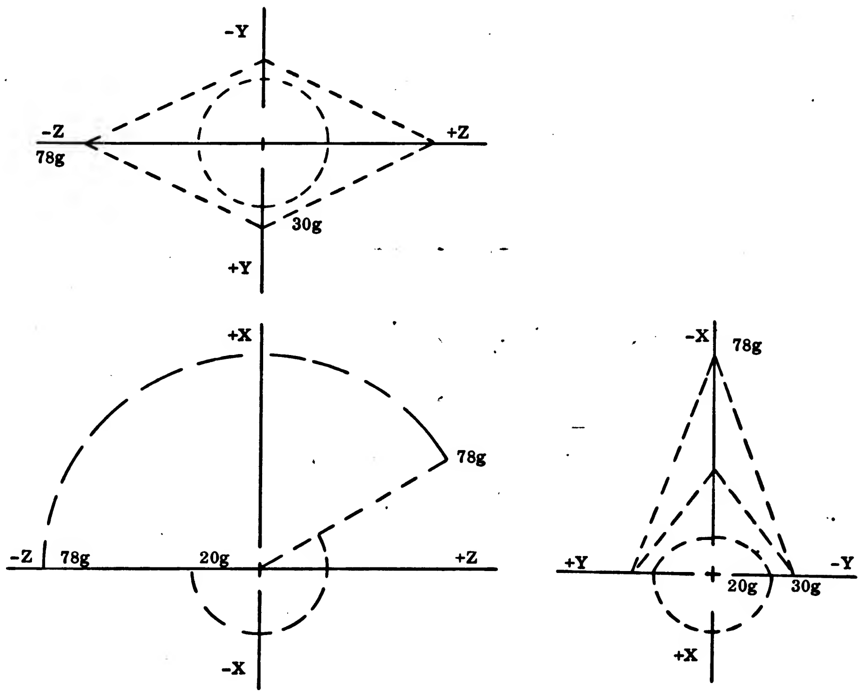


LUNAR LANDING
SHOCK MAGNITUDE TIME HISTORY
FIGURE 4



INTERNAL EQUIPMENT ULTIMATE DESIGN ACCELERATIONS

FIGURE 5



INTERNAL EQUIPMENT ULTIMATE DESIGN ACCELERATIONS

FIGURE 5

b. Lunar Landing, LEM. The time history of the following shock magnitudes is shown in Figure 4. The shock magnitudes are based on a rigid LEM with flexible landing gear and a 1.6 magnification factor.

X Axis: +8.0g
Y Axis: ±8.0g
Z Axis: ±8.0g

c. Docking, LEM and Block II. Docking condition and time history to be supplied when available.

d. Earth Landing, Block II. Terminal peak saw-tooth pulse of 78g (peak amplitude) with total duration 10 to 15 milliseconds, including decay time on greater than 10 percent of the total duration. The GN&C shall cause no hazard to the crew as a result of this shock. Figure 5 defines the acceleration.

3.3.3 Vibration. The following vibration levels and rates shall be applied by the LEM primary structure, including panels, to the G&N equipment supports, and by the CM to the Block II equipment along each of the three mutually perpendicular axes.

a. Launch and Boost

(1) LEM (Reference ICD LIS-520-10001)

(a) Input to Equipment Supports from Exterior Primary Structure
(Use for IMU, AOT, DSKY, NVB, PTA, Wiring Harness "B")

Random: Applied for 5 minutes per axis.

10-23 Hz, 12 db/octave rise to 0.0148 g^2/Hz
23-80 Hz, 0.0148 g^2/Hz
80-110 Hz, 12 db/octave rise to 0.0444 g^2/Hz
110-950 Hz, 0.0444 g^2/Hz
950-1200 Hz, 12 db/octave rolloff to 0.0148 g^2/Hz
1200-2000 Hz, 0.0148 g^2/Hz

Sinusoidal: Swept at a rate of 3 octaves per minute, 5 to 100 Hz to 5 Hz continuous sweep, 0.154 inch double amplitude from 5 to 18.5 Hz, 2.69g from 18.5 to 100 Hz.

(b) Input to Equipment Supports from Interior Primary Structure
(Use for LGC, CDU, PSA/SCA, Wiring Harness "A")

Random: Applied for 5 minutes per axis.

10-23 Hz, 12 db/octave rise to 0.0148 g^2/Hz
23-80 Hz, 0.0148 g^2/Hz

b. Lunar Landing, LEM. The time history of the following shock magnitudes is shown in Figure 4. The shock magnitudes are based on a rigid LEM with flexible landing gear and a 1.6 magnification factor.

X Axis: +8.0g
Y Axis: ±8.0g
Z Axis: ±8.0g

c. Docking, LEM and Block II. Docking condition and time history to be supplied when available.

d. Earth Landing, Block II. Terminal peak saw-tooth pulse of 78g (peak amplitude) with total duration 10 to 15 milliseconds, including decay time on greater than 10 percent of the total duration. The GN&C shall cause no hazard to the crew as a result of this shock. Figure 5 defines the acceleration.

3.3.3 Vibration. The following vibration levels and rates shall be applied by the LEM primary structure, including panels, to the G&N equipment supports, and by the CM to the Block II equipment along each of the three mutually perpendicular axes.

a. Launch and Boost

(1) LEM (Reference ICD LIS-520-10001)

(a) Input to Equipment Supports from Exterior Primary Structure
(Use for IMU, AOT, DSKY, NVB, PTA, Wiring Harness "B")

Random: Applied for 5 minutes per axis.

10-23 Hz, 12 db/octave rise to 0.0148 g^2/Hz
23-80 Hz, 0.0148 g^2/Hz
80-110 Hz, 12 db/octave rise to 0.0444 g^2/Hz
110-950 Hz, 0.0444 g^2/Hz
950-1200 Hz, 12 db/octave rolloff to 0.0148 g^2/Hz
1200-2000 Hz, 0.0148 g^2/Hz

Sinusoidal: Swept at a rate of 3 octaves per minute, 5 to 100 Hz to 5 Hz continuous sweep, 0.154 inch double amplitude from 5 to 18.5 Hz, 2.69g from 18.5 to 100 Hz.

(b) Input to Equipment Supports from Interior Primary Structure
(Use for LGC, CDU, PSA/SCA, Wiring Harness "A")

Random: Applied for 5 minutes per axis.

10-23 Hz, 12 db/octave rise to 0.0148 g^2/Hz
23-80 Hz, 0.0148 g^2/Hz

80-100 Hz, 12 db/octave rise to 0.0355 g^2/Hz
100-1000 Hz, 0.0355 g^2/Hz
1000-1200 Hz, 12 db/octave rolloff to 0.0148 g^2/Hz
1200-2000 Hz, 0.0148 g^2/Hz

Sinusoidal: Swept at a rate of 3 octaves per minute, 5 to 100 Hz to 5 Hz continuous sweep, 0.154 inch double amplitude from 5 to 16 Hz, 1.92g from 16 to 100 Hz.

During the launch and boost phase of flight, the LEM is exposed to random vibration of varied levels and spectra for 17 minutes. During all but approximately 2.5 minutes of this period, the intensity of the random vibration is of such a low level that it is considered to be of negligible design significance. In addition, the launch and boost environment is considered to include peak vibration levels which are represented by the above sinusoidal vibration envelopes. The number of sinusoidal peaks for design may be considered to be 1 percent of the natural frequency of the equipment and its supporting structure times the number of seconds exposure. For design purposes, the above random spectrum and sinusoidal levels applied separately for 5 minutes along each of the three mutually perpendicular axes, X, Y and Z are considered to adequately represent the vibration environment. Grumman will supply the influence coefficients of the navigation base supporting the IMU. All other equipment is effectively mounted on primary structure.

(2) Block II (Reference ICD MH01-01348-416: Input to Equipment

Random: 10-80 Hz, 3 db/octave rise to 0.06 g^2/Hz
80-400 Hz, 0.06 g^2/Hz
400-2000 Hz, 3 db octave rolloff

Time Duration: See Figure 6

b. Translunar Space: Inputs to Block II Equipment (Reference ICD MH01-01348-416)

Random: 20-100 Hz, 3 db/octave rise to 0.005 g^2/Hz
100-2000 Hz, 0.005 g^2/Hz

Time Duration: 12.5 minutes

c. Lunar Descent and Ascent

(1) Inputs to LEM Ascent Stage Equipment (Use for all equipment) Reference ICD LIS-520-10001)

Random: Applied for 21 minutes per axis.

10-20 Hz, 12 db/octave rise to 0.0201 g^2/Hz
20-100 Hz, 0.0201 g^2/Hz
100-120 Hz, 12 db/octave rolloff to 0.010 g^2/Hz
120-2000 Hz, 0.010 g^2/Hz

80-100 Hz, 12 db/octave rise to 0.0355 g^2/Hz
100-1000 Hz, 0.0355 g^2/Hz
1000-1200 Hz, 12 db/octave rolloff to 0.0148 g^2/Hz
1200-2000 Hz, 0.0148 g^2/Hz

Sinusoidal: Swept at a rate of 3 octaves per minute, 5 to 100 Hz to 5 Hz continuous sweep, 0.154 inch double amplitude from 5 to 16 Hz, 1.92g from 16 to 100 Hz.

During the launch and boost phase of flight, the LEM is exposed to random vibration of varied levels and spectra for 17 minutes. During all but approximately 2.5 minutes of this period, the intensity of the random vibration is of such a low level that it is considered to be of negligible design significance. In addition, the launch and boost environment is considered to include peak vibration levels which are represented by the above sinusoidal vibration envelopes. The number of sinusoidal peaks for design may be considered to be 1 percent of the natural frequency of the equipment and its supporting structure times the number of seconds exposure. For design purposes, the above random spectrum and sinusoidal levels applied separately for 5 minutes along each of the three mutually perpendicular axes, X, Y and Z are considered to adequately represent the vibration environment. Grumman will supply the influence coefficients of the navigation base supporting the IMU. All other equipment is effectively mounted on primary structure.

(2) Block II (Reference ICD MH01-01348-416: Input to Equipment

Random: 10-80 Hz, 3 db/octave rise to 0.06 g^2/Hz
80-400 Hz, 0.06 g^2/Hz
400-2000 Hz, 3 db octave rolloff

Time Duration: See Figure 6

b. Translunar Space: Inputs to Block II Equipment (Reference ICD MH01-01348-416)

Random: 20-100 Hz, 3 db/octave rise to 0.005 g^2/Hz
100-2000 Hz, 0.005 g^2/Hz

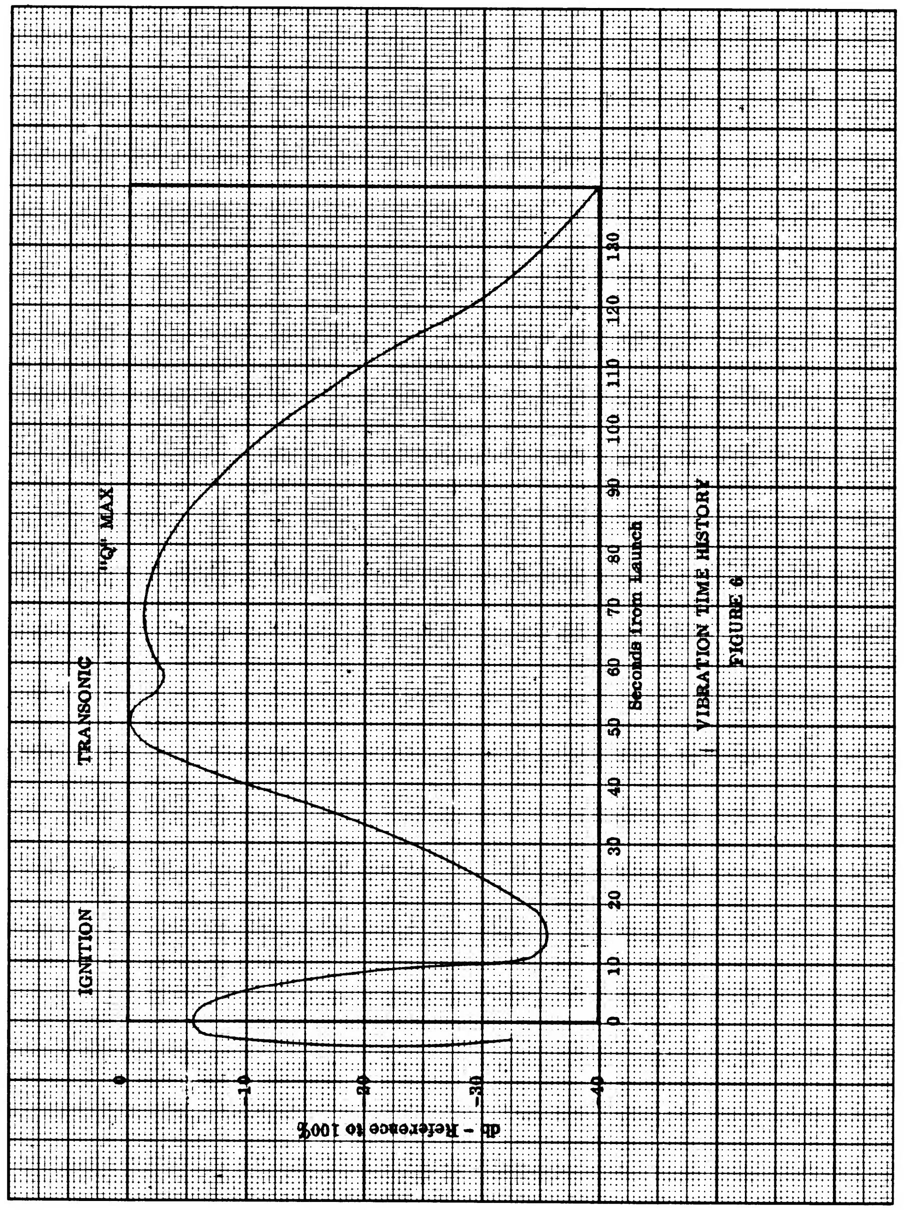
Time Duration: 12.5 minutes

c. Lunar Descent and Ascent

(1) Inputs to LEM Ascent Stage Equipment (Use for all equipment) Reference ICD LIS-520-10001)

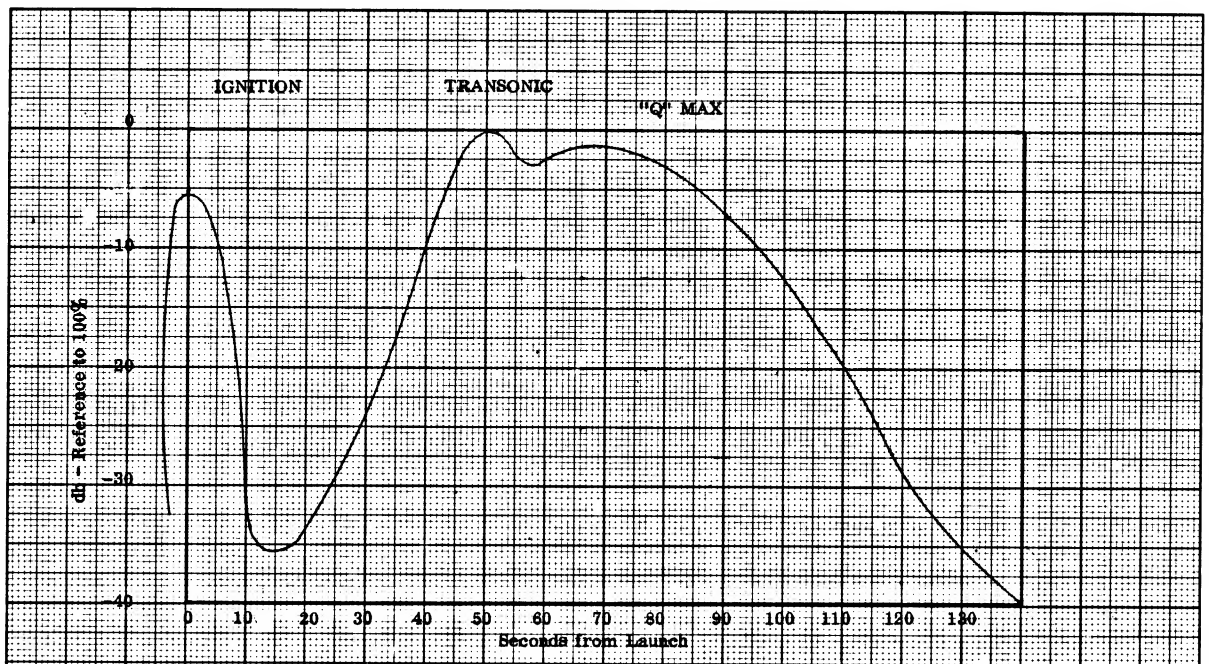
Random: Applied for 21 minutes per axis.

10-20 Hz, 12 db/octave rise to 0.0201 g^2/Hz
20-100 Hz, 0.0201 g^2/Hz
100-120 Hz, 12 db/octave rolloff to 0.010 g^2/Hz
120-2000 Hz, 0.010 g^2/Hz



VIBRATION TIME HISTORY

FIGURE 6



VIBRATION TIME HISTORY

FIGURE 6

Sinusoidal: Swept at a rate of 0.5 octave per minute, 1 sweep from 5 to 100 Hz to 5 Hz, 5 through 17 Hz 0.10 inch double amplitude, 17 to 100 Hz 1.54g.

(2) Inputs to Navigation Base Assembly (NVB): The following vibration environments are the current best estimates for mission or operational simulation. These represent the calculated response near the LEM navigation base due to anticipated engine oscillatory thrust using current LEM modes. They may be utilized as inputs from the NBS (Navigation Base Support) to the NVB (Navigation Base) for purpose of performance evaluation, not for structural design.

Linear Vibration:

Lunar Descent: 20-30 Hz, 20 db/octave increase to 0.003 g^2/Hz
30-50 Hz, 0.003 g^2/Hz
50-86 Hz, 30 db/octave decrease to 0.001 g^2/Hz
86-2000 Hz, 0.001 g^2/Hz

Lunar Ascent: 20-100 Hz, 0.005 g^2/Hz
100-136 Hz, 20 db/octave increase to 0.00025 g^2/Hz
136-184 Hz, 0.00025 g^2/Hz
184-240 Hz, 30 db/octave decrease to 0.00001 g^2/Hz
240-2000 Hz, 0.00001 g^2/Hz

d. Entry: Inputs to Block II Equipment (Reference ICD MH01-01348-416)

Random: 10-80 Hz, 3 db/octave rise to 0.006 g^2/Hz
80-400 Hz, 0.006 g^2/Hz
400-2000 Hz, 3 db/octave rolloff

e. Launch Abort: Inputs to Block II Equipment (Reference ICD MH01-01348-416)

Random: Vibration applied for 10 seconds

10-80 Hz, 3 db/octave rise to 0.06 g^2/Hz
80-2000 Hz, 0.06 g^2/Hz

3.3.4 Pressure

a. Launch and Boost

(1) LEM (Reference ICD LIS-520-10001) (See Figure 7:) Cabin environment varies from 20.5 psia pressure at sea level to 5.4 psia (O_2). Equipment Outside the Crew Cabin: Atmospheric pressure at sea level to 1 x 10^{-8} mm Hg (N_2).

Sinusoidal: Swept at a rate of 0.5 octave per minute, 1 sweep from 5 to 100 Hz to 5 Hz, 5 through 17 Hz 0.10 inch double amplitude, 17 to 100 Hz 1.54g.

(2) Inputs to Navigation Base Assembly (NVB): The following vibration environments are the current best estimates for mission or operational simulation. These represent the calculated response near the LEM navigation base due to anticipated engine oscillatory thrust using current LEM modes. They may be utilized as inputs from the NBS (Navigation Base Support) to the NVB (Navigation Base) for purpose of performance evaluation, not for structural design.

Linear Vibration:

Lunar Descent: 20-30 Hz, 20 db/octave increase to 0.003 g^2/Hz
30-50 Hz, 0.003 g^2/Hz
50-86 Hz, 30 db/octave decrease to 0.001 g^2/Hz
86-2000 Hz, 0.001 g^2/Hz

Lunar Ascent: 20-100 Hz, 0.005 g^2/Hz
100-136 Hz, 20 db/octave increase to 0.00025 g^2/Hz
136-184 Hz, 0.00025 g^2/Hz
184-240 Hz, 30 db/octave decrease to 0.00001 g^2/Hz
240-2000 Hz, 0.00001 g^2/Hz

d. Entry: Inputs to Block II Equipment (Reference ICD MH01-01348-416)

Random: 10-80 Hz, 3 db/octave rise to 0.006 g^2/Hz
80-400 Hz, 0.006 g^2/Hz
400-2000 Hz, 3 db/octave rolloff

e. Launch Abort: Inputs to Block II Equipment (Reference ICD MH01-01348-416)

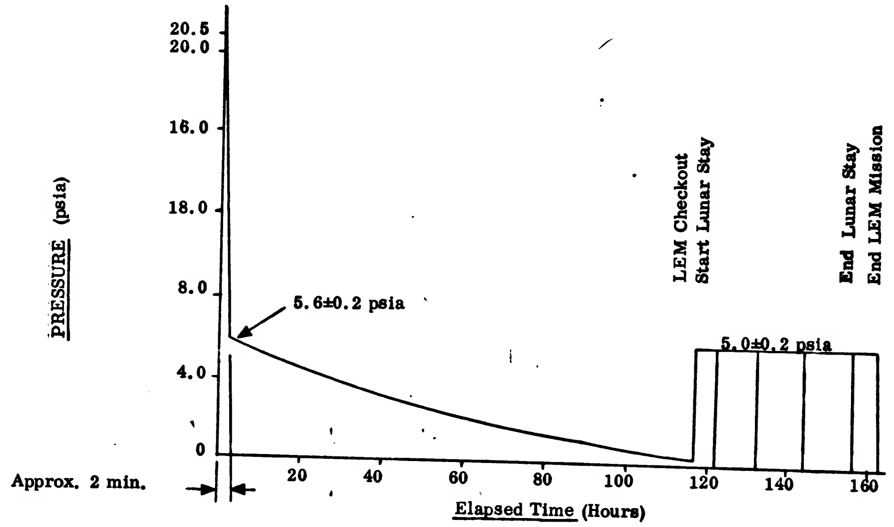
Random: Vibration applied for 10 seconds

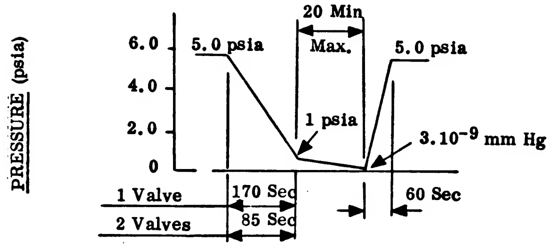
10-80 Hz, 3 db/octave rise to 0.06 g^2/Hz
80-2000 Hz, 0.06 g^2/Hz

3.3.4 Pressure

a. Launch and Boost

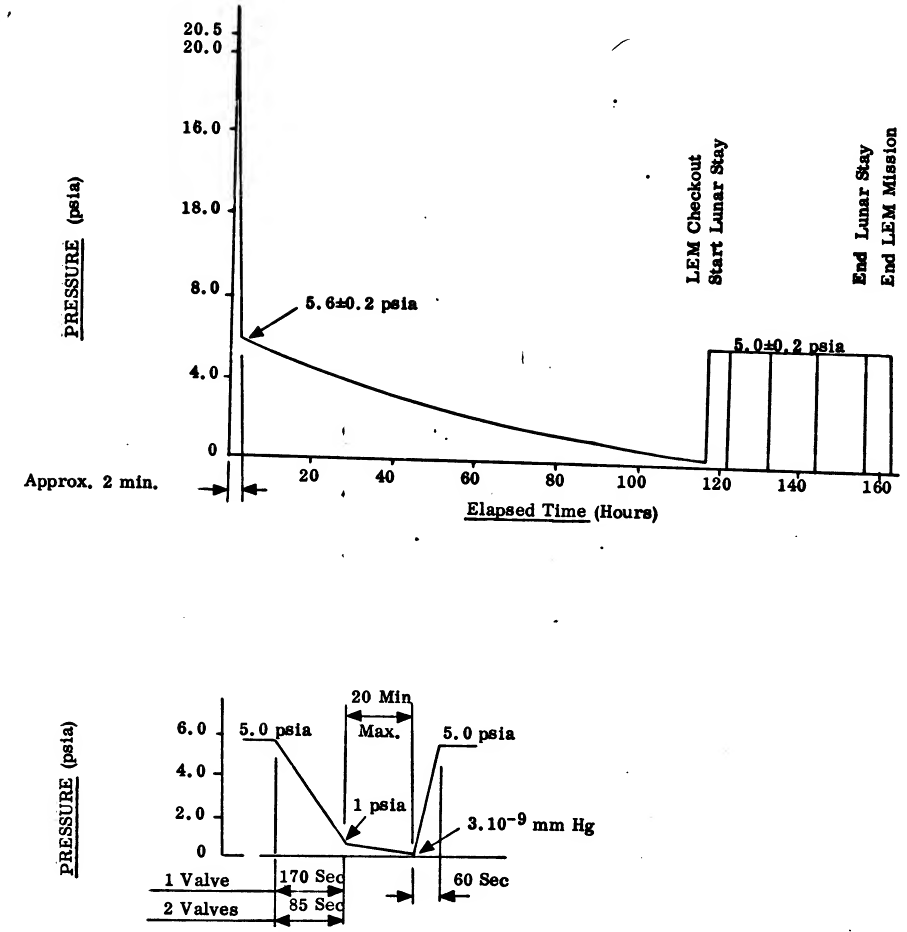
(1) LEM (Reference ICD LIS-520-10001) (See Figure 7:) Cabin environment varies from 20.5 psia pressure at sea level to 5.4 psia (O_2). Equipment Outside the Crew Cabin: Atmospheric pressure at sea level to 1 x 10^{-8} mm Hg (N_2).





Nominal Blow-Down & Recompression Time

LEM CREW COMPARTMENT ENVIRONMENT
PRESSURE VS. ELAPSED TIME
FIGURE 7



Nominal Blow-Down & Recompression Time

LEM CREW COMPARTMENT ENVIRONMENT
PRESSURE VS. ELAPSED TIME
FIGURE 7

(2) Block II (Reference ICD MH01-01348-416): CM Interior: 14.7 psia nominal decreasing to 6.0 psia.

b. Translunar Space

(1) LEM (Reference ICD LIS-520-10001): Cabin environment from 4.8 to 5.2 psia controlled cabin (0_2); 5.8 psia to 0.1 psia uncontrolled cabin (0_2). Equipment between the heat shield and the crew cabin: 1 x 10^{-10} mm Hg uncontrolled vacuum. Equipment outside heat shield: 1 x 10^{-14} mm Hg (Space).

(2) Block II (Reference ICD MH01-01348-416): CM Interior: 6.0 psia decreasing to 5.0 psia (parking orbit only); 5.0±0.2 psia (normal) for 336 hours; 1.0 x 10^{-4} mm Hg (emergency and during EVA) for 100 hours.

c. Lunar Descent and Ascent. LEM (Reference ICD LIS-520-10001): Cabin environment from 4.8 to 5.2 psia controlled cabin (0_2). Equipment between the heat shield and the crew cabin: 1 x 10^{-10} mm Hg uncontrolled vacuum. Equipment outside the heat shield: 1 x 10^{-12} mm Hg (uncontrolled vacuum on surface of moon).

d. Lunar Stay. LEM (Reference ICD L1S-520-10001): Cabin environment from 4.8 to 5.2 psia controlled cabin (0_2); 3 x 10^{-9} mm Hg cabin (hatch open) hatch open condition exists for a maximum of 20 minutes for each opening. Design for a total of 4 repressurizations. Equipment outside the crew cabin: 1 x 10^{-10} mm Hg uncontrolled vacuum.

e. Entry. Block II (Reference ICD MH01-01348-416): 5.0 psia increasing to 5.5 psia (nominal).

f. Earth Descent. Block II (Reference ICD MH01-01348-416): 5.5 psia (nominal) increasing to 14.7 psia (nominal).

3.3.5 Humidity

3.3.5.1 LEM (Reference ICD L1S-520-10001). Humidity products are composed mainly of perspiration and breath moisture. Minor amounts are due to water escaping from the reconstitution of food systems and outgassing of materials. The following environments apply as shown in Table V.

(2) Block II (Reference ICD MH01-01348-416): CM Interior: 14.7 psia nominal decreasing to 6.0 psia.

b. Translunar Space

(1) LEM (Reference ICD LIS-520-10001): Cabin environment from 4.8 to 5.2 psia controlled cabin (0_2); 5.8 psia to 0.1 psia uncontrolled cabin (0_2). Equipment between the heat shield and the crew cabin: 1 x 10^{-10} mm Hg uncontrolled vacuum. Equipment outside heat shield: 1 x 10^{-14} mm Hg (Space).

(2) Block II (Reference ICD MH01-01348-416): CM Interior: 6.0 psia decreasing to 5.0 psia (parking orbit only); 5.0±0.2 psia (normal) for 336 hours; 1.0 x 10^{-4} mm Hg (emergency and during EVA) for 100 hours.

c. Lunar Descent and Ascent. LEM (Reference ICD LIS-520-10001): Cabin environment from 4.8 to 5.2 psia controlled cabin (0_2). Equipment between the heat shield and the crew cabin: 1 x 10^{-10} mm Hg uncontrolled vacuum. Equipment outside the heat shield: 1 x 10^{-12} mm Hg (uncontrolled vacuum on surface of moon).

d. Lunar Stay. LEM (Reference ICD L1S-520-10001): Cabin environment from 4.8 to 5.2 psia controlled cabin (0_2); 3 x 10^{-9} mm Hg cabin (hatch open) hatch open condition exists for a maximum of 20 minutes for each opening. Design for a total of 4 repressurizations. Equipment outside the crew cabin: 1 x 10^{-10} mm Hg uncontrolled vacuum.

e. Entry. Block II (Reference ICD MH01-01348-416): 5.0 psia increasing to 5.5 psia (nominal).

f. Earth Descent. Block II (Reference ICD MH01-01348-416): 5.5 psia (nominal) increasing to 14.7 psia (nominal).

3.3.5 Humidity

3.3.5.1 LEM (Reference ICD L1S-520-10001). Humidity products are composed mainly of perspiration and breath moisture. Minor amounts are due to water escaping from the reconstitution of food systems and outgassing of materials. The following environments apply as shown in Table V.

TABLE V

HUMIDITY

ALL EQUIPMENT WITHIN CREW CABIN	ALL EQUIPMENT OUTSIDE CREW CABIN	TIME (Max)
1) None	None *	4.8 hrs
2) 40-70% - Controlled Cabin	None	2.5 hrs
0-100% - Uncontrolled Cabin	None	117.5 hrs
3) 40-70% - Controlled Cabin	None	
0-100% - Locally in Cabin	None	48.0 hrs

* Dry Nitrogen Purge just prior to launch.

3.3.5.2 Block II (Reference ICD MH01-01348-416). Zero to 100 percent relative humidity for 336 hours, including conditions where condensation takes place in the form of water or frost.

3.3.6 Thermal Environments. The Guidance and Navigation equipment shall be capable of proper operation in the thermal environments while being cooled by the environmental control subsystem. The thermal design requirements and interfaces will be specified herein. The thermal control of the Guidance and Navigation (G&N) equipment is, in general, based on an active thermal control system wherein the equipment is conductively coupled to a coolant which must be capable of accepting all of the internally dissipated power and environmental heat inputs. The coupling of the actively cooled G&N equipment to the coolant loop will be accomplished by either integral cooling lines or attachment of the equipment to cold plates. Low power level equipment will be cooled passively.

3.3.6.1 LEM (Reference ICD LIS-510-10001):

a. Integral Cooling. The inertial Measurement Unit (IMU) will be cooled by permanently affixed cooling lines which are attached to the LEM ECS loop by quick disconnects.

b. Cold Plate Cooling. The LEM Power and Servo Assembly (LPSA), Coupling Display Units (CDU), LEM Guidance Computer (LGC) and Pulse Torque Assembly (PTA) will be cooled by the attachment of their heat sink surfaces to Grumman supplied cold plates.

c. Passive Cooling. The LEM Display and Keyboard (DSKY) and Alignment, Optical Telescope (AOT) shall be passively cooled.

d. Cooling Parameters. The thermodynamic properties and requirements of the LEM environmental control subsystem for the three types of G&N equipment are as specified herein.

TABLE V

HUMIDITY

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c. Passive Cooling. The LEM Display and Keyboard (DSKY) and Alignment, Optical Telescope (AOT) shall be passively cooled.

d. Cooling Parameters. The thermodynamic properties and requirements of the LEM environmental control subsystem for the three types of G&N equipment are as specified herein.

e. **Coolant Properties.** The approximate chemical composition and the physical properties of the LEM environmental control coolant will be as follows. The coolant will be approximately 35% ethylene glycol ($HOCH_2CH_2OH$) and 65 percent water (H_2O) by weight with Triathanolamine-phosphate (TEAP) and Sodium mercaptobazothiozol (NaMCBT) inhibitors.

3.3.6.1.1 Integral Cooling Lines

a. **Coolant Flow Rates.** The mass flow rate of the environmental control coolant to the IMU cooling loop during manned phases of mission will be 33±5 pounds per hour. During unmanned translunar flight, there will be no coolant flow to the IMU.

b. **Coolant System Pressure.** The maximum design operating pressure for the coolant loop shall be 60 psig. The design proof pressure shall be 90 psig.

c. **Coolant Pressure Drop.** The maximum pressure drop through the IMU cooling loop including both halves of the disconnects shall be between 0.3 psi and 0.4 psi at a coolant flow rate of 33 lb/hr and inlet temperature of 40°F.

d. **Coolant Temperature Variations.** The inlet coolant temperature variations for the IMU will vary from 32°F to 50°F.

3.3.6.1.2 Cold Plate Cooling

a. **Coolant Flow Rate.** The LGC, CDU and LPSA cold plates are connected in series in the ECS loop. The flow rate to the LGC, CDU and LPSA coolant loop will be 33±5 lb/hr. The flow rate to the PTA cold plate will be 33±5 lb/hr. During unmanned translunar flight, there will be no coolant flow to the PGNS equipment cold plates.

b. **Coolant Temperature Variations.** The inlet coolant temperature to the LGC, CDU and LPSA coolant loop during manned phases of the mission will be 32°F to 50°F.

c. **Interface Conductance.** For design purposes, the thermal gradient across the interface between the equipment heat sink surface and the environmental control coolant shall be assumed to be five (5)°F for every watt per square inch of power dissipated to the cold plates.

3.3.6.1.3 **Leakage Rate.** The maximum leakage from the integrally cooled G&N equipment shall be as specified herein.

a. **Integral Heat Exchangers.** The maximum allowable leakage for each MIT supplied heat exchanger, including all permanent joints and all seals, shall be 5×10^{-6} std. cc/sec. of helium at 77.5 psig.

e. **Coolant Properties.** The approximate chemical composition and the physical properties of the LEM environmental control coolant will be as follows. The coolant will be approximately 35% ethylene glycol ($HOCH_2CH_2OH$) and 65 percent water (H_2O) by weight with Triathanolamine-phosphate (TEAP) and Sodium mercaptobazothiozol (NaMCBT) inhibitors.

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b. **Coolant System Pressure.** The maximum design operating pressure for the coolant loop shall be 60 psig. The design proof pressure shall be 90 psig.

c. **Coolant Pressure Drop.** The maximum pressure drop through the IMU cooling loop including both halves of the disconnects shall be between 0.3 psi and 0.4 psi at a coolant flow rate of 33 lb/hr and inlet temperature of 40°F.

d. **Coolant Temperature Variations.** The inlet coolant temperature variations for the IMU will vary from 32°F to 50°F.

3.3.6.1.2 Cold Plate Cooling

a. **Coolant Flow Rate.** The LGC, CDU and LPSA cold plates are connected in series in the ECS loop. The flow rate to the LGC, CDU and LPSA coolant loop will be 33±5 lb/hr. The flow rate to the PTA cold plate will be 33±5 lb/hr. During unmanned translunar flight, there will be no coolant flow to the PGNS equipment cold plates.

b. **Coolant Temperature Variations.** The inlet coolant temperature to the LGC, CDU and LPSA coolant loop during manned phases of the mission will be 32°F to 50°F.

c. **Interface Conductance.** For design purposes, the thermal gradient across the interface between the equipment heat sink surface and the environmental control coolant shall be assumed to be five (5)°F for every watt per square inch of power dissipated to the cold plates.

3.3.6.1.3 Leakage Rate. The maximum leakage from the integrally cooled G&N equipment shall be as specified herein.

a. **Integral Heat Exchangers.** The maximum allowable leakage for each MIT supplied heat exchanger, including all permanent joints and all seals, shall be 5×10^{-6} std. cc/sec. of helium at 77.5 psig.

b. Disconnects. The maximum leakage for each disconnect in the fully connected condition shall be 12 x 10^{-8} std. cc/sec. of helium at 77.5 psig.

3.3.6.1.4 Passive Cooling. The display Panel and AOT must be capable of operating in the environments specified in 3.3.6.1.6.a and 3.3.6.1.6.b. In addition, the AOT must be capable of accepting a maximum heat load of 9 watts from the LEM Abort Sensor Assembly when the AOT is at 0°F.

3.3.6.1.5 Surface Characteristics. Equipment surfaces shall conform to the following requirements.

a. Surface Temperatures. The temperatures of the external surfaces of actively cooled G&N equipment shall not exceed 120°F during any portion of the vehicle mission.

b. Surface Coatings. The surface coatings required for the actively and passively controlled G&N equipment are as follows:

(1) Actively Cooled Equipment: External surfaces, with the exception of heat sink surfaces, of the LGC, CDU, LPSA and PTA shall have an infrared emittance of 0.40 or less in the region of the electromagnetic spectrum between 5 microns and 35 microns.

(2) Passively Cooled Equipment: Surfaces of the display panel and the AOT exposed to the interior of the LEM vehicle shall have an infrared emittance of at least 0.9 in order to be compatible with the environment of 3.3.6.1.6.a

3.3.6.1.6 Thermal Environment. The thermal interchange of the G&N equipment with the surroundings will be to the extent specified herein.

a. Radiant Interchange with LEM Vehicle. The temperature of the surfaces in radiant contact with the PGNS equipment will vary from 0°F to 130°F during unmanned transslunar flight, and from 0°F to 160°F during manned phases of the mission.

b. Conductive Interchange with the LEM Vehicle. The LGC, CDU, LPSA, PTA and their cold plates will be conductively isolated from LEM structure. The conduction resistance between the IMU and its mounting structure shall be 1.4°F/watt or greater. The temperature of the IMU mounting structure shall be 0°F to 130°F during unmanned translunar flight, and 0°F to 160°F during manned phases of the mission.

3.3.6.1.7 Equipment Power Dissipation. The maximum average power dissipation for the G&N equipment is as follows:

LGC - 100 watts - Operate Mode
10 watts - Standby Mode

b. **Disconnects.** The maximum leakage for each disconnect in the fully connected condition shall be 12 x 10^{-8} std. cc/sec. of helium at 77.5 psig.

3.3.6.1.4 **Passive Cooling.** The display Panel and AOT must be capable of operating in the environments specified in 3.3.6.1.6.a and 3.3.6.1.6.b. In addition, the AOT must be capable of accepting a maximum heat load of 9 watts from the LEM Abort Sensor Assembly when the AOT is at 0°F.

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3.3.6.1.6 **Thermal Environment.** The thermal interchange of the G&N equipment with the surroundings will be to the extent specified herein.

a. **Radiant Interchange with LEM Vehicle.** The temperature of the surfaces in radiant contact with the PGNS equipment will vary from 0°F to 130°F during unmanned translunar flight, and from 0°F to 160°F during manned phases of the mission.

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3.3.6.1.7 **Equipment Power Dissipation.** The maximum average power dissipation for the G&N equipment is as follows:

LGC - 100 watts - Operate Mode
10 watts - Standby Mode

CDU - 68 watts

LPSA - 110 watts - IMU in Operate Mode
18 watts - IMU in Standby Mode

PTA - 79 watts

Displays - 19 watts

AOT - 15 watts

IMU - 113 watts - Operate Mode
44 watts - Standby Mode

3.3.6.2 Block II (Reference ICD MH01-01349-416)

3.3.6.2.1 Coolant Characteristics and Requirements

a. **Composition.** The following coolant composition shall be used in the spacecraft liquid coolant loop. The applicable procurement specification is NAA HB 0110-006.

Glycol per Specification MIL-E-7500
Triple Distilled Water
Basic Solution composed of:

62.500 parts by weight of glycol

37.422 parts by weight of water

1.563 parts by weight of Inhibitor No. 1 - Triathanolamine phosphate (TEAP)

0.156 parts by weight of Inhibitor No. 2 - Sodium mercaptobanzothiozol (NaMCBT)

101.641

b. **System Pressure.** The maximum design operating pressure for the liquid coolant loop shall be 60 psig. The design proof pressure shall be 90 psig.

c. **Temperature Variations.** The lower, steady state temperature limit presently anticipated is 54°F, applicable to lunar orbit with minimum thermal load. This does not apply to the NBA; see 3.3.6.2.2 for NBA temperature.

3.3.6.2.2 Navigation Base Assembly (NBA) Coolant Requirements.

a. **Steady State Inlet Temperature.** The IMU steady inlet temperature in all modes shall be 45° ±10°F.

CDU - 68 watts

LPSA - 110 watts - IMU in Operate Mode
18 watts - IMU in Standby Mode

PTA - 79 watts

Displays - 19 watts

AOT - 15 watts

IMU - 113 watts - Operate Mode
44 watts - Standby Mode

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c. Temperature Variations. The lower, steady state temperature limit presently anticipated is 54°F, applicable to lunar orbit with minimum thermal load. This does not apply to the NBA; see 3.3.6.2.2 for NBA temperature.

3.3.6.2.2 Navigation Base Assembly (NBA) Coolant Requirements.

a. Steady State Inlet Temperature. The IMU steady inlet temperature in all modes shall be 45° ±10°F.

b. Flow Rate. 33 lbs/hr ± 3 lbs/hr Nominal; Max Flow Rate, 48 lbs/hr; Min Flow Rate, 25 lbs/hr.

c. Pressure Drop. 1.6 psi max., between input and output including flexible hoses and both halves of quick disconnects at 33 lbs/hr and inlet temperature of 45°F.

d. Inertial Measuring Unit (IMU) Thermal Load. The IMU incorporates an integral heat exchanger. The electrical loads imposed on the coolant loop are 100 watts max. avg. and 80 watts nom.

3.3.6.2.3 Allowable Leakage Rates, Navigation Base Assembly

a. Integral Heat Exchangers. The maximum allowable leakage for the MIT supplied integral heat exchanger including all permanent joints and all seals shall be 5 x 10^{-6} std. cc/sec of helium at 77.5 psig.

b. Quick Disconnects:

(1) Connected: The maximum leakage for each quick disconnect in the fully connected condition shall be 12 x 10^{-6} std. cc/sec of helium at 77.5 psig.

(2) Connecting: The maximum gaseous inclusion shall be 0.01 std. cu. in. of oxygen (0.16 cu. in.) per connector per connection. A maximum total of 10 connecting operations on the launch pad is assumed. Liquid leakage, if applicable, shall be as specified below.

(3) Disconnecting: The maximum liquid leakage per connector per disconnect operation shall be 1/2 drop (0.0333 ga) of coolant. For pad operation, means shall be provided for collecting and removing from the spacecraft 100 percent of coolant leakage from such operations.

3.3.6.2.4 G&N Local Thermal Environments

a. IMU and CDUJB - Surrounding Structure:

Design Temperature: 100°F max
95°F nom
60°F min
Surface Emmissivity: E = 0.8 max

b. **Flow Rate.** 33 lbs/hr ± 3 lbs/hr Nominal; Max Flow Rate, 48 lbs/hr; Min Flow Rate, 25 lbs/hr.

c. **Pressure Drop.** 1.6 psi max., between input and output including flexible hoses and both halves of quick disconnects at 33 lbs/hr and inlet temperature of 45°F.

d. **Inertial Measuring Unit (IMU) Thermal Load.** The IMU incorporates an integral heat exchanger. The electrical loads imposed on the coolant loop are 100 watts max. avg. and 80 watts nom.

3.3.6.2.3 Allowable Leakage Rates, Navigation Base Assembly

a. **Integral Heat Exchangers.** The maximum allowable leakage for the MIT supplied integral heat exchanger including all permanent joints and all seals shall be 5×10^{-6} std. cc/sec of helium at 77.5 psig.

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3.3.6.2.4 G&N Local Thermal Environments

a. IMU and CDUJB - Surrounding Structure:

Design Temperature: 100°F max
95°F nom
60°F min
Surface Emmissivity: E = 0.8 max

b. PSA Support Structure:

Design Temperature: 100°F max
60°F min

c. AGC Support Structure:

Design Temperature: 95°F max
60°F min

d. Estimated Convection Coefficient:

In-Flight: 0.15 to 0.20
Pre-Launch: 0.75

3.3.7 Corrosive Contaminants. The following condition applies to the CM interior. Salt atmosphere as caused by human perspiration, the effect of which is simulated by exposure to a 1 percent salt solution by weight for 48 hours.

3.3.8 Electromagnetic Interference

3.3.8.1 LEM (Reference ICD LIS-520-10001)

a. Radio Frequency. Background radio frequency radiation levels shall not exceed the susceptibility limits specified in Specification MIL-I-26600/MSC-ASPO-EMI-10A.

b. Power Supply Transients and Ripple. The LEM equipment shall be capable of operating with power line transient voltages of +50 volts and -100 volts maximum amplitude, having a duration of 10 μ sec and a repetition rate of 10 pps, and shall be capable of operating with power line ripple voltage of ±1.5 volts peak having frequency components from 20 cps to 20 kc. The transient and ripple voltages are superimposed on the steady state power line voltage.

3.3.8.2 Block II Electromagnetic Capability. No Requirements.

b. PSA Support Structure:

Design Temperature: 100°F max
60°F min

c. AGC Support Structure:

Design Temperature: 95°F max
60°F min

d. Estimated Convection Coefficient:

In-Flight: 0.15 to 0.20
Pre-Launch: 0.75

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3.3.8.2 Block II Electromagnetic Capability. No Requirements.

4. TEST REQUIREMENTS

4.1 GENERAL. This section establishes the qualification test requirements for all LEM and Block II G&N equipment. Qualification tests shall consist of exposure of production hardware to the specified environmental conditions to assure that it shall meet the design requirements and perform its intended mission function. During the environmental exposures, the equipment shall be operative or nonoperative, depending on its condition during actual mission encountered environments. Both natural and induced environments are included in the test programs. The test articles subjected to qualification tests shall (1) be manufactured with the same tooling processes, quality control procedures, and (2) be representative of the same design as normal production units destined for flight equipment.

4.1.1 Prior Compliance. The Apollo G&N equipment shall have successfully met all requirements of the applicable inspection and acceptance test requirements as delineated in the SCD (Specification Control Drawing), PS (Purchase Specification), or FTM (Final Test Method) prior to being submitted for qualification testing as defined in this specification. Data from the inspection and acceptance shall be recorded and shall form a part of the qualification test data.

4.1.2 Atmospheric Conditions. Unless otherwise specified, tests shall be performed at room ambient atmospheric pressure, a temperature of 73° ±10° F, and a relative humidity of 80 percent maximum.

4.1.3 Instrumentation and Data. Instrumentation and data acquisition equipment shall be used to assure a sufficient data record of the environmental parameters controlled, and of the test article parameters critical to end item performance within the confinement of the testing facility. Additional parameters may be recorded as secondary data to assist in failure isolation, evaluation information, etc., at the discretion of the testing activity. Special care shall be taken to provide signal isolation and prevent circuit loading such that the data acquisition system has a minimum effect on equipment performance.

4.1.4 Failures

4.1.4.1 General. A failure occurs when the equipment under test is unable to perform its intended function within specified tolerances. Any failure shall be completely documented and reported utilizing the Apollo G&N failure reporting system. Formal qualification testing of the failed item shall be discontinued until the failure is resolved. Unless otherwise directed, when corrective action has been accomplished the test item shall be resubjected to the test phase where the failure occurred and the test sequence continued from that point. Changes in the absolute value of critical parameters will require individual evaluation prior to re-establishing a new measurement base. If, while the test item is being resubjected to a test phase, a totally unrelated failure occurs, it shall be reported, evaluated, and the proper corrective action accomplished; but it shall not be considered a qualification failure, and therefore, testing shall be continued from that point. At any point in the test program where corrective action results in replacement

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4.1.4.2 Failure of Test Facility. If the test facility fails, the equipment under test shall be rechecked and the test continued in the manner in which the test facility malfunction will result in a minimum effect upon the qualification of the equipment under test. Component failures induced by test facility failure shall be recorded, analyzed, and the component repaired, but shall not be considered relevant to G&N equipment qualification.

4.1.5 Reporting. System and subsystem qualification tests and interim reports are required at approximately monthly intervals. Final reports are required for each G&N part and equipment tested. Final reports shall be submitted to MIT/IL and NASA/MSC within 45 days following completion of the total test effort and at a minimum must include:

a. Test plan and procedure or a reference to this document.

b. Deviations from plan if any

c. Acceptance data

d. Photos, diagrams, description, etc., of test articles and setups where significant or unique

e. Summary of failures and corrective action

f. Test results

g. Test data and analyses

h. Conclusions

4.1.6 Examination of Equipment. The equipment shall be visually inspected for mechanical discrepancies before and after being subjected to each environmental exposure.

4.1.7 Test Conditions. The input excitation and output loading of the G&N system shall be in accordance with the applicable test plan. Cold plates shall be utilized per normal equipment installation and the coolant temperature flow rate shall be in accordance with the applicable test plan.

4.1.8 Performance. The test articles shall meet the requirements of the applicable test plan before, during where specified, and after exposure in each environment.

4.1.9 Witnessing Personnel. The NASA representative or his designated alternate shall be notified of all tests in advance of their scheduled performance.

of a component, this component shall be considered qualified by similarity in all previous environmental exposures, unless failure analysis proves otherwise. If there is repeated failure, malfunction or out-of-tolerance performance in a given environment, this shall be recorded, analysis performed, and the equipment repaired and rechecked and then subjected to the next scheduled environment pending review and resolution with MIT and NASA representatives.

4.1.4.2 Failure of Test Facility. If the test facility fails, the equipment under test shall be rechecked and the test continued in the manner in which the test facility malfunction will result in a minimum effect upon the qualification of the equipment under test. Component failures induced by test facility failure shall be recorded, analyzed, and the component repaired, but shall not be considered relevant to G&N equipment qualification.

4.1.5 Reporting. System and subsystem qualification tests and interim reports are required at approximately monthly intervals. Final reports are required for each G&N part and equipment tested. Final reports shall be submitted to MIT/IL and NASA/MSC within 45 days following completion of the total test effort and at a minimum must include:

a. Test plan and procedure or a reference to this document.

b. Deviations from plan if any

c. Acceptance data

d. Photos, diagrams, description, etc., of test articles and setups where significant or unique

e. Summary of failures and corrective action

f. Test results

g. Test data and analyses

h. Conclusions

4.1.6 Examination of Equipment. The equipment shall be visually inspected for mechanical discrepancies before and after being subjected to each environmental exposure.

4.1.7 Test Conditions. The input excitation and output loading of the G&N system shall be in accordance with the applicable test plan. Cold plates shall be utilized per normal equipment installation and the coolant temperature flow rate shall be in accordance with the applicable test plan.

4.1.8 Performance. The test articles shall meet the requirements of the applicable test plan before, during where specified, and after exposure in each environment.

4.1.9 Witnessing Personnel. The NASA representative or his designated alternate shall be notified of all tests in advance of their scheduled performance.

4.1.10 Marking of Qualification Test Samples. All assemblies, subassemblies or piece parts which have been subjected to qualification testing on the APOLLO Program and are being returned to productive divisions for repair or following the qualification test sequence and prior to final disposition of the test articles, all units and all reusable items removed from a unit shall be marked as follows:

a. Marking and Identification. All articles shall be marked with yellow characters 1/4 inch high. The words "QUAL TEST" shall be used to identify this type hardware.

b. Marking Location. Where feasible, location of marking shall be adjacent to the part number and readily visible from the assembled position. Those articles which cannot be marked due to size limitations shall be identified by tagging or bagging and marking the tag or bag.

c. Marking Application. Marking shall be accomplished utilizing ink which conforms to Drawing SCD 1006271-001.

4.1.11 Disposition of Test Samples. The samples tested shall be retained for a minimum of 3 years following completion of the contract or unless otherwise directed by NASA.

4.2 TEST REQUIREMENTS. The LEM and Block II equipment to be subjected to the environments as shown in the following paragraphs are displayed in Table VI. Items requiring requalification due to design changes are listed in Table VII. The following Block II or LEM items have been or will be qualified as a result of the Block I Qualification Tests either directly or by similarity and need not be tested to the Block II environments as specified herein.

a. Optical Unit Assembly
b. Optics Shroud Assembly
c. Eyepiece Storage Compartment
d. Bellows

4.2.1 Acceleration. The axes of application apply for all equipment except the inertial components of the Inertial Measurement Unit. For each environment, the inertial components are exposed to the acceleration shown in the ±X, ±Y, and ±Z inertial component axes. All six axes are qualified during each exposure provided the IMU is run inertial on a centrifuge.

4.2.1.1 LEM Acceleration. The LEM equipment shall be exposed to the environment in the following configurations:

TABLE VI

QUALIFICATION OF LEM AND BLOCK II EQUIPMENT

		LEM							BLOCK II							
	SN	Vib	Shock	Accel	T/V	Humidity	C.A.	GT	Vib	Shock	Accel	T/V	Humidity	C.A.	GT	EMI
IMU	604	4.2.3.1	4.2.2.1	4.2.1.1	4.2.6.1	4.2.5	4.2.7	4.2.4	4.2.3.2	4.2.2.2	4.2.1.2.2	Note 1	Note 1	Note 1	Note 1	-
	203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.2.8
Nav Base	604	-	-	4.2.1.1	-	-	-	-	-	-	-	-	-	-	-	-
	605	4.2.3.1	4.2.2.1	-	4.2.6.1	4.2.5	4.2.7	4.2.4	-	-	-	-	-	-	-	-
	203	-	-	-	-	-	-	-	4.2.3.2	4.2.2.2	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	4.2.8
AOT	604	4.2.3.1	4.2.2.1	4.2.1.4	4.2.6.1	4.2.5	4.2.7	4.2.4	-	-	-	-	-	-	-	-
CCRD	604	4.2.3.1	4.2.2.1	4.2.1.4	4.2.6.1	4.2.5	4.2.7	4.2.4	-	-	-	-	-	-	-	-
PSA	604	4.2.3.1	4.2.2.1	4.2.1.1	4.2.6.1	4.2.5	4.2.7	4.2.4	-	-	-	-	-	-	-	-
	203	-	-	-	-	-	-	-	4.2.3.2	4.2.2.2	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	4.2.8
SCA	604	4.2.3.1	4.2.2.1	4.2.1.4	4.2.6.1	4.2.5	4.2.7	4.2.4	-	-	-	-	-	-	-	-
	203	-	-	-	-	-	-	-	4.2.3.2	4.2.2.2	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	4.2.8
PTA	604	4.2.3.1	4.2.2.1	4.2.1.1	4.2.6.1	4.2.5	4.2.7	4.2.4	-	-	-	-	-	-	-	-
PEA	203	-	-	-	-	-	-	-	4.2.3.2	4.2.2.2	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	4.2.8
LGC/CMC		4.2.3.1	Note 1	4.2.1.3	4.2.6.1	4.2.5	4.2.7	4.2.4	4.2.3.2	4.2.2.2	4.2.1.2.2	Note 1	Note 1	Note 1	Note 1	4.2.8
DSKY		4.2.3.1	Note 1	4.2.1.3	4.2.6.1	4.2.5	4.2.7	4.2.4	4.2.3.2	4.2.2.2	4.2.1.2.2	Note 1	Note 1	Note 1	Note 1	4.2.8
CDU	604	4.2.3.1	Note 1	4.2.1.1	4.2.6.1	4.2.5	4.2.7	4.2.4	4.2.3.2	4.2.2.2	4.2.1.2.2	Note 1	Note 1	Note 1	Note 1	-
	203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.2.8
GNIC	203	-	-	-	-	-	-	-	4.2.3.2	4.2.2.2	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	4.2.8
Harness	604	4.2.3.1	4.2.2.1	4.2.1.1	4.2.6.1	4.2.5	4.2.7	4.2.4	-	-	-	-	-	-	-	-
	203	-	-	-	-	-	-	-	4.2.3.2	4.2.2.2.1	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	4.2.8
Hose	203	-	-	-	-	-	-	-	4.2.3.2	4.2.2.2	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	-
OUA	201 A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.2.8

Note 1 - The components identified by this note will be qualified in a combined LEM/Block II environment.

TABLE VII

QUALIFICATION OF LEM AND BLOCK II EQUIPMENT

UNIT	ENVIRONMENTS							
	VIB	SHOCK	ACCEL	T/V	HUM	CA	GT	EMI
Pulse Torque Power Supply	4.2.3.3	4.2.2.2	4.2.1.3 4.2.1.2.2	4.2.6.1	4.2.5	4.2.7	4.2.4	NR

a. The IMU on the navigation base together with a dummy ASA and a dummy AOT mounted on it. The PSA with a dummy SCA mounted on it. Airborne coldplates will be mounted to the PSA, PTA, and CDU. The A and B harnesses will interconnect the units insofar as possible. All units will be tested at the same time and the acceleration input will be measured to the center of gravity of the IMU.

b. The AOT/CCRD will be tested as a single unit and the acceleration input will be measured to the center of gravity of the combined unit.

c. All other units may be tested separately with the input measured to the center of gravity of the test sample.

d. Nominal coolant temperature/flow rate will be used.

4.2.1.1.1 LEM Launch Acceleration:

a. Acceleration: 6.0±1.0g
b. Duration: 5 minutes
c. Axes: +X, ±Y, ±Z LEM
d. Condition: Nonoperating

4.2.1.1.2 LEM Lunar Descent and Ascent Equipment Evaluation Acceleration

a. Acceleration: 3.0±0.5g
b. Duration: 5 minutes
c. Axes: +X, ±Y, ±Z LEM
d. Condition: Operating

4.2.1.1.3 LEM Lunar Landing Shock Acceleration

a. Acceleration: 10.0±1.0g
b. Duration: 15 to 30 seconds
c. Axes: +X, ±Y, ±Z LEM
d. Condition: Operating

4.2.1.2 Block II Acceleration. The Block II equipment shall be exposed to the following environments as follows:

a. The IMU will be mounted on the navigation base with a dummy OUA. The IMU, navigation base, PSA, PEA, CDU, and GNIC Panel will be tested at the same time, interconnected with the G&N harness, with the acceleration input measured to the center of gravity of the IMU.

b. All other units may be tested separately with the input measured to the center of gravity of the test sample.

4.2.1.2.1 Block II Launch Acceleration

a. Acceleration: 6.0±1.0g
b. Duration: 5 minutes
c. Axis: +X CM
d. Condition: Operating

4.2.1.2.2 Block II Launch and Entry Abort Acceleration

a. Acceleration: 18 +1, -0.5g
b. Duration: 5 minutes
c. Axis: +X CM
d. Condition: Operating

4.2.1.3 LEM and Block II Combined Acceleration. The LGC/CMC and DSKY may be tested separately with the acceleration input measured to the center of gravity of the test sample. LEM cold plates will be used.

a. Acceleration: 10±1.0g
b. Duration: 5 minutes
c. Axis: +X, ±Y, -Z LEM
d. Condition: Operating

4.2.1.4 LEM Combined Acceleration. The AOT/CCRD will be tested as a single unit. The LEM SCA will be tested on a dummy PSA. The acceleration input will be measured to the center of gravity of the test sample.

a. Acceleration: 10±1.0g
b. Duration: 5 minutes
c. Axis: +X, ±Y, ±Z LEM
d. Condition: AOT/CCRD Nonoperating
LEM SCA Operating

4.2.2 Shock. Shock tests shall be performed as follows using MIL-STD-810, Method 516.1 as a guide. Unless otherwise specified the shock level tolerance shall be ±10 percent and time duration tolerance ±10 percent. In the event that the shock test is conducted utilizing a vibration exciter and the tolerance limits specified above cannot be met, these limits may be broadened to account for the exciter dynamics; however, overshoot shall not exceed 75 percent of the peak g value. Shock will be performed in the same configuration as vibration, except dummies may be substituted for airborne components for earth landing shock.

4.2.2.1 LEM Lunar Landing and Flight Shock. The LEM equipment shall be exposed to one shock along each plus and minus direction of each of three orthogonal axes (6 shocks). Shocks shall be:

a. Magnitude: 10g minimum
b. Duration: 15 to 20 milliseconds
c. Shape: Terminal Peak Sawtooth
d. Condition: Operating

4.2.2.2 Block II Shock

4.2.2.2.1 Block II Flight Shock. The Block II equipment shall be exposed to one shock along each plus and minus direction of each of three orthogonal axes (6 shocks). Shocks shall be:

a. Magnitude: 20g
b. Duration: 6 milliseconds
c. Shape: Terminal Peak Sawtooth
d. Condition: Operating

4.2.2.2.2 Block II CM Earth Landing Shock. The Block II equipment shall be exposed to one shock each in the +X and +Z direction (2 shocks). Dummy equipment may be used for this test provided the actual equipment mounting configuration is simulated. Mounting provisions may be replaced between shocks.

a. Magnitude: 78g
b. Duration: 11 milliseconds
c. Shape: Terminal Peak Sawtooth
d. Condition: Nonoperating

4.2.3 Vibration. Vibration tests shall be conducted in accordance with the following paragraphs of MIL-STD-810, Method 514.1; Procedure 1, Random Vibration; Control and Analysis of Random Vibration paragraph 5.3, Vibration Input Control paragraph 9.4, and Transducer Mounting paragraph 9.4 of Section 9 entitled Test Details and Techniques. Tolerance limits between 10 and 50 Hz shall be ±3 db. In the event the ±1.5 db from 50 to 1000 Hz cannot be met with existing facilities, the tolerance may be broadened to ±3 db providing the overall g rms level is held to ±10 percent. If a multiple band pass random equalizer is used to develop the input spectra, these tolerances apply only to the center frequencies of the filters for roll-up or rolloff.

The random vibration shall be Gaussian distributed with the exception that magnitude limiting shall occur at a 3 to 1 peak-to-rms acceleration ratio. The spectra are defined by the straight line connections of the given coordinates on log-log graph paper.

All equipment exposed to the nonoperational condition shall have all power, coolant, etc., off (except IMU heater power). At a minimum, a short on-site performance check shall be conducted following each axis of vibration. The operating equipment shall be exercised and functionally checked as thoroughly as possible during the exposure. Recording instrumentation shall be provided where applicable to monitor equipment performance. For assembled configurations, dummies may be used for equipment not being qualified during a particular test run.

4.2.3.1 LEM Launch and Lunar Phase Vibration. The LEM equipment shall be subjected to the LEM Launch and Lunar Phase Vibration spectra along three orthogonal axes. The equipment is defined as follows:

LEM Navigation Base, Mounted on the Navigation Base Support, with IMU, AOT/CCRD, RGA and ASA.	Assembled with input to Navigation Base Support Mounting Points.
PSA and SCA with cold plate. ECDU with cold plate. PTA with cold plate. LGC with cold plate.	Assembled with input to Cold Plate Mounting Points.
Harnesses A and B	Input to Holding Fixture
DSKY	Input to Mounting Points

4.2.3.1.1 LEM Launch Vibration. The LEM Launch Vibration is given below by three spectra. The first spectrum applies to the Navigation Base Assembly, Harnesses A and B, and the PTA; and the second applies to the PSA/SCA Assembly. The third is a sine sweep and applies to all LEM equipment.

a. Navigation Base Assembly, Harnesses A and B, and PTA Spectrum Coordinates:

(1) 12 db/octave rollup from 10 Hz to: 0.025 g^2/Hz at 23 Hz
0.025 g^2/Hz at 80 Hz
0.075 g^2/Hz at 110 Hz
0.075 g^2/Hz at 950 Hz
0.025 g^2/Hz at 1200 Hz
0.025 g^2/Hz at 2000 Hz

(2) Time Duration: 2.5 minutes per axis
(3) Equipment Condition: Nonoperational

b. PSA/SCA Spectrum Coordinates:

(1) 12 db/octave rollup from 10 Hz to: 0.025 g^2/Hz at 23 Hz
0.025 g^2/Hz at 80 Hz
0.060 g^2/Hz at 100 Hz
0.060 g^2/Hz at 1000 Hz
0.025 g^2/Hz at 1200 Hz
0.025 g^2/Hz at 2000 Hz

(2) Time Duration: 2.5 minutes per axis
(3) Equipment Condition: Non Operative

c. Sine Sweep

(1) 5 to 100 to 5 Hz continuous sweep
(2) 0.154 inch double amplitude from 5-21.1 Hz
(3) 3.5 g peak from 21.1 to 100 Hz
(4) 3 octaves per minute
(5) Equipment Condition: Operational

4.2.3.1.2 LEM Lunar Phase Vibration. LEM equipment spectrum coordinates:

a. 12 db/octave rollup from 10 Hz to: 0.034 g^2/Hz at 20 Hz
0.034 g^2/Hz at 100 Hz
0.017 g^2/Hz at 120 Hz
0.017 g^2/Hz at 2000 Hz

b. Time Duration: 21 minutes
c. Equipment Condition: Operational

4.2.3.2 Block II Launch and Launch Abort Vibration. The Block II CM equipment shall be subjected to the Block II Launch Vibration along three orthogonal axes. The equipment is defined as follows:

Navigation Base with IMU, Hose Assembly, and dummy Bellows and dummy OUA.	Assembled with input to Navigation Base mounting points
PSA/SCA, PEA, GNIC Panel, CMC, DSKY, ECDU, and harness mounted on Cold Plates where applicable	Input to equipment or Cold Plate mounting points

a. Spectrum Coordinates:

(1) 3 db/octave rollup from 10 Hz to: 0.06 g^2/Hz at 80 Hz
0.06 g^2/Hz at 400 Hz

(2) 3 db/octave rolloff from 400 Hz to 2000 Hz
(3) Time Duration: 2.5 minutes
(4) Equipment Condition: Operational except OUA

b. Spectrum Coordinates:

(1) 3 db/octave rollup from 10 Hz to: 0.06 g^2/Hz at 80 Hz
0.06 g^2/Hz at 2000 Hz

(2) Time Duration: 30 seconds per axis
(3) Equipment Condition: Operational, except OUA

4.2.4 Ground Temperature. The ground temperature conditions are described herein. The test sequence may be interrupted between lettered steps to facilitate scheduling problems, etc.; however, it is desired to complete the total cycle once it has been initiated. Unless otherwise specified, the temperature and pressure tolerances are ±5°F and ±0.5 psi. The rate of temperature change shall not exceed 30°F per minute. The temperature shall be chamber air ambient temperature.

The G&N equipment shall be subjected to the ground temperature condition as indicated in Figure 8 and detailed below. During the exposure the equipment shall be operating during the specified times during which it shall be exercised as completely as possible and checked within the limits imposed by chamber confinement. At all other times all coolant, power, etc., including gyro suspension shall be off (IMU heater power shall be on to maintain platform temperature). If the test sequence is interrupted, the equipment shall be functionally checked prior to reinitiating the test sequence. The equipment shall be mounted on airborne coldplates where normally provided, which shall be attached to a mounting fixture conductively isolated from the coldplate except at the mounting points. Non coldplate mounted G&N equipment shall have a fixture equipment interface temperature of 0°F minimum to 150°F maximum.

a. 24 hours minimum at -20°F
b. Raise temperature to +20°F in one hour
c. Stabilize at +20°F for 4 hours
d. Maintain +20°F for duration of functional check (4 hour minimum)
e. Raise the temperature from +20°F to +140° +0, -5°F in 2 hours
f. Maintain +140° +0, -5°F for 24 hours.
g. Reduce the temperature to 107°F in one hour and stabilize at 107°F for 4 hours
h. Maintain 107°F for duration of functional check (4 hours minimum)

4.2.4.1 Equipment Configuration.

a. LEM - The IMU, Navigation Base, PSA, PTA, CDU on a LEM coldplate, and Harness will be exposed at the same time.

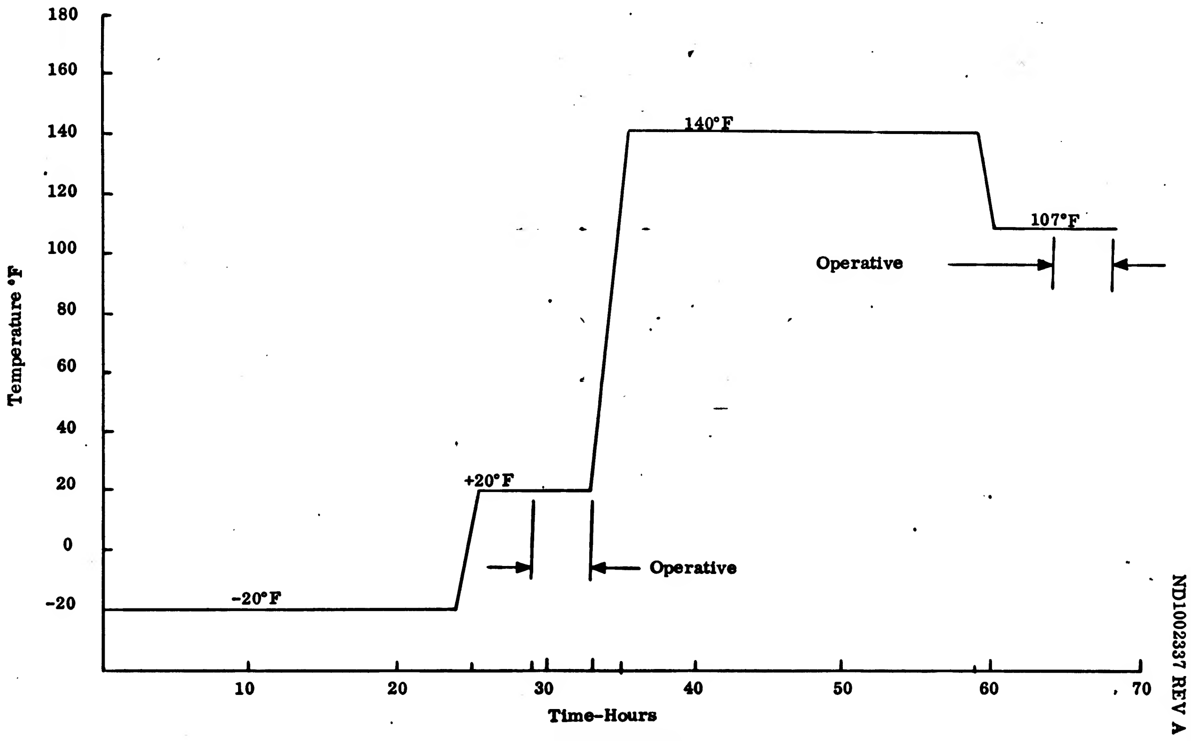
b. Block II - The PSA, Navigation Base, PEA, GNIC, Hoses, and as much of the harness as possible will be exposed at the same time. The support IMU and CDU will not be exposed.

c. The AOT/CCRD will be exposed as a single unit.

d. The LGC/CMC and DSKY will be exposed at the same time using LEM coldplates.

e. All other units may be exposed separately.

4.2.5 Humidity Temperature. The humidity environment shall be five 24 hour humidity cycles in accordance with Method 507.1 of MIL-STD-810 except the maximum temperature shall be



G&N SYSTEM OPERATIONAL CYCLE GROUND TEMPERATURE

FIGURE 8

120°F. The temperature shall be raised from 70°F to 120°F in 2 hours, 120°F shall be maintained for 6 hours minimum and then the temperature shall be gradually reduced to 70°F over the next 16 hours.

The G&N equipment shall be subjected to the humidity test as indicated. During the test, the equipment shall be interconnected with the airborne harness insofar as possible, and operated in all equipment modes and exercised as thoroughly as possible except during the portion of each cycle where the temperature is above 105°F. During the portion of each cycle when the ambient temperature is above 105°F, the equipment shall be off, except for coolant flow and power required for normal heat, suspension, etc.

4.2.5.1 Equipment Configuration

a. LEM - The IMU, Navigation Base, PSA, PTA, CDU on a LEM coldplate, and Harness will be exposed at the same time.

b. Block II - The PSA, Navigation Base, PEA, GNIC, Hoses, and as much of the harness as possible will be exposed at the same time. The support IMU and CDU will not be exposed.

c. The AOT/CCRD will be exposed as a single unit.

d. The LGC/CMC and DSKY will be exposed at the same time using LEM coldplates.

e. All other units may be exposed separately.

4.2.6 Thermal Vacuum. The thermal vacuum conditions are described herein. Unless otherwise indicated the time of exposure to an environment does not include the time required to attain that environment. The test sequence may be interrupted between lettered steps to facilitate scheduling problems, etc.; however, it is desired to complete the total cycle once it has been initiated. Unless otherwise specified, the temperature and pressure tolerances are ±5°F and ±0.5 psi. The rate of air temperature change shall not exceed 30°F per minute and the rate of pressure change shall not exceed 5 psia per minute.

The G&N equipment shall be subjected to the thermal vacuum condition as indicated and as detailed herein. During the exposure the equipment shall be operating (except where specified) during which it shall be exercised as completely as possible and checked within the limits imposed by chamber confinement. At all other times all coolant, power, etc., including gyro suspension shall be off (IMU heater power shall be on to maintain platform temperature). If the test sequence is interrupted, the equipment shall be functionally checked prior to reinitiating the test sequence. The equipment shall be mounted on airborne coldplates where normally provided, which shall be attached to a mounting fixture conductively isolated from the coldplate except at the mounting points. Non coldplate mounted Block II G&N equipment shall have a fixture equipment interface temperature of +20°F minimum to +135°F maximum. Non coldplate mounted LEM G&N equipment shall have a fixture equipment interface temperature of 0°F minimum to 150°F maximum. The equipment configuration shall be as specified in 4.2.4.1.

Definition of coldplate and heat exchanger conditions are as follows:

a. Nominal: Nominal flow rate and input temperature.

b. Maximum: Highest inlet temperature and lowest flow rate with the exception that the coldplate interface temperature shall be monitored and temperature and/or flow rate shall be varied to prevent the interface temperature from exceeding that specified in the applicable ICD.

c. Minimum: Lowest inlet temperature and highest flow rate.

d. Off: No coolant flow.

4.2.6.1 LEM Thermal Vacuum. The LEM G&N equipment shall be subjected to the conditions detailed herein. The space exposed portions of the AOT external to the meteor shield shall be tested to condition (p) simultaneously while the internal meteor shield and cabin portions are exposed to the LEM conditions (a) through (o), except the internal meteor shield portions shall be exposed to the space pressure conditions. The AOT shall be checked intermittently during long duration operational exposures. The equipment shall be operating unless otherwise stated.

a. Air Temperature: 75°F
Pressure: 5.00±0.25 psia
Cold Plate Condition: Nominal
Duration: 24 hours

b. Wall Temperature: 75°F
Pressure: 1×10^{-4} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 12 hours

c. Wall Temperature: Raise from 75°F to 150°F
Pressure: Reduce from 1×10^{-4} mm Hg to 1×10^{-7} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 4 hours

d. Wall Temperature: 150°F
Pressure: 1×10^{-7}mm Hg maximum
Cold Plate Condition: Nominal
Duration: 48 hours

e. Wall Temperature: Reduce from 150°F to 0°F
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 4 hours

f. Wall Temperature: 0°F
Pressure: 1 x 10^{-7} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 48 hours

g. Wall Temperature: Raise from 0°F to 130°F
Pressure: 1 x 10^{-7} mm Hg maximum
Cold Plate Condition: From Nominal to Off
Duration: 4 hours
Equipment Condition: Off

h. Wall Temperature: 130°F
Pressure: 1 x 10^{-7} mm Hg
Cold Plate Condition: Off
Duration: 12 hours
Equipment Condition: Off

i. Wall Temperature: 160°F
Pressure: 1 x 10^{-7} mm Hg maximum
Cold Plate Condition: Maximum
Duration: 12 hours

j. Wall Temperature: Reduce from 160°F to 0°F
Pressure: 1 x 10^{-7} mm Hg maximum
Cold Plate Condition: From Maximum to Off
Duration: 4 hours

k. Wall Temperature: 0°F
Pressure: 1 x 10^{-7} mm Hg maximum
Cold Plate Condition: Off
Duration: 12 hours
Equipment Condition: Nonoperating

m. Wall Temperature: 0°F
Pressure: 1 x 10^{-7} mm Hg maximum
Cold Plate Condition: Minimum
Duration: 12 hours
Equipment Condition: Operating

n. Wall and Air Temperature: Raise from 0°F to 75° ±20°F
Pressure: Raise from 1 x 10^{-7} mm Hg to 5.00 ± 0.25 psia
Cold Plate Condition: From Minimum to Nominal
Duration: 2 hours

o. Wall and Air Temperature: 75° ±20°F

Pressure: 5.00 ± 0.25 with the exception of two pressure blowdown cycles. Each blowdown cycle shall consist of a reduction in pressure to below 0.1 psia in 2.0 ± 1.0 minutes, maximum facility pumping for 20 minutes, and repressurization to 5.00 ± 0.25 psia in 1.0 ± 0.5 minutes.

Cold Plate Condition: Nominal

Duration: 10 hours

Space condition external to LEM

p. Cold Wall Temperature: -300° ±20°F

Pressure: 1×10^{-7} mm Hg maximum

Solar Radiation: Two exposures to solar radiation at one solar constant for 8 hours each occurring once each during Steps (m) and (i). MIL-STD-810, Method 517.1 shall be used as a guide.

4.2.6.2 Block II Thermal Vacuum. The G&N equipment peculiar to the CM, including the GNIC, PEA, PSA and G&N Harness shall be subjected to the Block II Thermal Vacuum Test Conditions at the same time.

a. Air Temperature: 75°F
Pressure: 5.00 ± 0.25 psia
Cold Plate Condition: Nominal
Duration: 24 hours

b. Wall Temperature: 75°F
Pressure: 1×10^{-4} to 1×10^{-5} mm Hg
Cold Plate Condition: Nominal
Duration: 12 hours

c. Wall Temperature: Raise from 75°F to 135°F
Pressure: 1×10^{-4} to 1×10^{-5} mm Hg
Cold Plate Condition: Nominal to Maximum
Duration: 4 hours

d. Wall Temperature: 135°F
Pressure: 1×10^{-4} to 1×10^{-5} mm Hg
Cold Plate Condition: Maximum
Duration: 48 hours

e. Wall Temperature: Reduce from 135°F to 20°F
Pressure: 1×10^{-4} to 1×10^{-5} mm Hg
Cold Plate Condition: Maximum to Minimum
Duration: 1 to 3 hours

f. Wall Temperature: 20°F
Pressure: 1×10^{-4} to 1×10^{-5} mm Hg
Cold Plate Condition: Minimum
Duration: 48 hours

g. Wall and Air Temperature: Raise from 20°F to 75° ±20°F
Pressure: Raise from (f) to Room Ambient
Cold Plate Condition: Minimum to Nominal
Duration: --

4.2.7 Cabin Atmosphere. The cabin atmosphere conditions are described herein. Unless otherwise indicated the time of exposure to an environment does not include the time required to attain that environment. The test sequence may be interrupted between lettered steps to facilitate scheduling problems, etc.; however, it is desired to complete the total cycle once it has been initiated. Unless otherwise specified, the temperature and pressure tolerances are ±5°F and ±0.5 psi. The rate of temperature change shall not exceed 30°F per minute and the rate of pressure change shall not exceed 5 psia per minute. The temperature shall be chamber air ambient temperature.

The G&N equipment shall be subjected to the cabin atmosphere condition as indicated and detailed herein. During the exposure the equipment shall be operating and shall be exercised as completely as possible and checked within the limits imposed by chamber confinement. If the test sequence is interrupted, the equipment shall be functionally checked prior to reinitiating the test sequence. The equipment shall be mounted on airborne coldplates where normally provided, which shall be attached to a mounting fixture conductively isolated from the coldplate except at the mounting points. Coolant shall be supplied at nominal flow rate and inlet temperature. The LEM AOT/CCRD and LEM SCA shall be subjected to steps a, b and c only. Equipment configuration shall be as specified in 4.2.4.1.

a. Air Temperature: 75°F
Pressure: 21 psia
Oxygen: 95±5%
Duration: 2 hours

b. Air Temperature: 75°F
Pressure: 14.7 psia
Oxygen: 95±5%
Duration: 12 hours

c. Air Temperature: 105°F
Pressure: 14.7 psia
Oxygen: 95±5%
Duration: 12 hours

d. Air Temperature: 75°F
Pressure: 5 psia
Oxygen: 95±5%
Duration: 24 hours

During this 24 hour exposure, a 1 percent by weight salt spray solution fog shall be intermittently imposed on the equipment 6 hours on and 6 hours off, for a total salt spray exposure of 12 hours. MIL-STD-810 Method 509.1 may be used as a guide.

4.2.8 Electromagnetic Interference (EMI). The EMI level and susceptibility of the G&N equipment shall be determined from Specification MIL-I-26600/MSC-ASPO-EMI-10A. During this test, the equipment shall be operational in all equipment modes and exercised as completely as possible. Out-of-tolerance conditions shall be recorded and considered by NASA/MSC and MIT/IL. Modification shall be made only after an incompatibility with other systems or equipment is found. Equipment to be tested will be interconnected as a Block II G&N System and consist of the following:

IMU/NB (Block II)
PSA/SCA (Block II)
PEA
LGC (LEM)
DSKY (1)
CDU (LEM)
GNIC Panel
G&N Harness
OUA

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with Specification ND1002214.

6. NOTES. None

APOLLO G&N Specification
ND1002337 REV B
Original Issue Date: 7/6/66
Release Authority: TDRR 30130
Class A Release

APOLLO G&N ENVIRONMENTAL QUALIFICATION SPECIFICATION FOR BLOCK II AND LEM EQUIPMENT

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
1/5/67	A	32483	1-60 Was 60 pages; now 43 pages.	MGM EA	WLS
5/18/67	B	33817	35-43. Was 43 pages now 44.	MGM EA	WLS

This specification consists of page 1 to 44 inclusive.

APPROVALS	NASA/MSC	J. Kent 7/5/66	W.S.Stameris 7/5/66	M.G.Marley 7/6/66	AC
			MIT/IL		

APOLLO G&N Specification
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This specification consists of page 1 **to** 60 **inclusive.**

APPROVALS	NASA/MSC	5 Jul 66 WStameris 7-6-66 MIT/IL 5 July 66	ACSP

1. SCOPE

1.1 GENERAL

It is the purpose of this document to establish the requirements and tests for demonstrating the qualification status of the LEM and Block II Guidance and Navigation System design and production for the earth orbital and ultimate lunar rendezvous-landing mission, and shows the degree of testing which must be satisfactorily accomplished.

1.2 ENVIRONMENTAL CONDITIONS

The environmental conditions and stress levels given bear a direct relationship to specifications describing spacecraft conditions. Varying equipment locations and mounting provisions have been taken into consideration. Transportation, handling, and storage conditions occurring during the normal life cycle of the equipment have been utilized to modify the tests appropriately either by adjustment of stress level or duration of application in order to optimize the simulation. The profiles within this specification encompass these nonflight conditions but are identified by the maximum level of each environmental exposure. Combinations of environments have been specified where facility considerations permit. Combinations of environments have also been used to qualification test equipment common to LEM and Block II.

1.3 QUALIFICATION CRITERIA

The qualification of the Block II and LEM Apollo Guidance and Navigation equipment shall be accomplished by subjecting each unit to the applicable tests specified herein. Full qualification status is subject to completion of the specified tests and resolution of all failures.

1.4 TEST PLANS AND PROCEDURES

Detailed test plans shall be prepared by the responsible contractor for each item subjected to qualification testing. The detailed test plan shall be submitted to MIT/IL and NASA/MSC for approval at least 30 days prior to the scheduled start of the test. After approval of a test plan, necessary revisions shall be supplied to MIT/IL and NASA/MSC in a timely manner.

1.5 EQUIPMENT CONFIGURATION

The LEM and Block II equipment qualified shall consist of the following. See Table 4.1 for test requirements and equipment to be tested.

1.5.1 LEM Equipment

(a)	Inertial Measurement Unit	(IMU)
(b)	LEM Navigation Base	(NVB)
(c)	Alignment Optical Telescope	(AOT)
(d)	Computer Control and Retical Dimmer	(CCRD)
(e)	Power and Servo Assembly (LEM)	(PSA)
(f)	Signal Conditioner Assembly	(SCA)
(g)	Pulse Torque Assembly	(PTA)
(h)	LEM Guidance Computer	(LGC)
(i)	Electronic Coupling Data Unit	(ECDU)
(j)	Display and Keyboard	(DSKY)
(k)	A and B Harnesses	

1.5.2 Block II Equipment

(a)	Inertial Measurement Unit	(IMU)
(b)	Block II Navigation Base	(NVB)
(c)	Power and Servo Assembly (Block II)	(PSA)

(d)	Signal Conditioner	(SC)
(e)	PIPA Electronics Assembly	(PEA)
(f)	Command Module Guidance Computer	(CMC)
(g)	Electronic Coupling Data Unit	(ECDU)
(h)	Display and Keyboard	(DSKY)
(i)	Eyepiece Stowage Compartment	(ESC)
(j)	Optical Unit Assembly	(OUA)
(k)	Optics Shroud Assembly	
(l)	Bellows	
(m)	G&N Interconnection Harness	
(n)	Hose Assembly	
(o)	Display and Controls	(D&C)

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES

The following documents shall form a part of this specification to the extent specified herein. Unless otherwise specified, the issue in effect on the date of this specification shall apply.

2.2 REFERENCES

(1)	MIL-I-26600	Interference Control Requirements, Aeronautical Equipment (Military)
(2)	MSC-ASPO-EM-10A	Addendum to MIL-I-26600 (NASA)
(3)	MIL-STD-810	Environmental Test Methods for Aerospace and Ground Equipment (Military)
(4)	ICD MH01-01348-416	Guidance Navigation and Control Subsystem Environments (North American Aviation, Inc.)
(5)	ICD MH01-01349-416	Guidance and Navigation (G&N) Thermal Requirements for Block II Apollo Guidance Equipment (AGE) (North American Aviation, Inc.)
(6)	ICD LIS-510-10001	Thermodynamic Requirements of Guidance and Navigation Equipment (Grumman Aircraft Engineering Corporation)
(7)	ICD LIS-520-10001	LEM Design Environment (Grumman Aircraft Engineering Corporation)

3. REQUIREMENTS

3.1 GENERAL

The environmental requirements of this section are indicative of the operational, transportation, handling, and storage environments for the airborne Apollo equipment components. They are extracted from the applicable ICD's and are given here for reference only.

3.2 FACTORY-TO-USE POINT ENVIRONMENTS

These requirements shall apply, unless otherwise specified, under the requirements for the particular equipment component.

3.2.1 Transportation, Handling and Storage

The following represent the environmental extremes which may be encountered by the equipment in a nonoperating condition during transportation, handling, and storage. The equipment may be protected by suitable packaging for transportation and storage if these environments exceed the design operating requirements. The equipment shall be capable of meeting the operating performance requirements of its performance specification after exposure to these environments while protected by its normal packaging:

a. Natural
b. Induced

3.2.1.1 Natural Environments, Block II (Reference 4)

The natural environments to which the equipment may be exposed while protected by its normal packaging shall be as follows:

a. Air Temperature

(1) Air Transportation: -45°F. to +140°F. for 8 hours.

(2) Ground Transportation: -20°F. to +145°F. for 2 weeks.

(3) Storage: +25°F. to 105°F. for 3 years.

b. Pressure

(1) Air Transportation: 3.47 psia minimum (35,000 feet altitude) for 8 hours.

(2) Ground Transportation and Storage: 11.78 psia minimum (6,000 feet altitude) for 3 years.

c. Humidity

0 to 100 percent relative humidity, including conditions wherein condensation takes place in the form of water or frost, for at least 30 days.

d. Sunshine

Solar radiation of 360 BTU/sq.ft/hr. for 6 hours per day for 2 weeks.

e. Rain

0.6 in/hr maximum for 12 hours, 2.5 in/hr for 1 hour.

f. Salt Spray

Salt atmosphere as encountered in coastal areas, the effort of which is simulated by exposure to a 5 percent salt solution by weight for 48 hours.

3.2.1.2 Natural Environments, Block II Transportation in Command Module (Ref. 4)

The following conditions apply to the CM interior during aircraft transportation, subsequent to GN&C installation:

a. Temperature: -20°F. minimum to 110°F. maximum

b. Pressure: 9.47 psia

c. Humidity: < 35% Relative Humidity

3.2.1.3 Induced Environments, Block II (Reference 4)

The induced environments to which the equipment may be exposed while protected by its normal packaging shall be as follows:

a. Shock

The design shock levels applicable to protective packaging shall be those resulting from free-fall drop in accordance with Table 3.1. The protective packaging shall attenuate shock such that packaged equipment shall not be exposed to shock levels exceeding the equipment design operating requirements.

TABLE 3.1

PACKAGING SHOCK

WEIGHT*1 (pounds)	DIMENSIONS*2 (inches,max)	DROP HEIGHT (inches)		
		FREE FALL	EDGEWISE	CORNERWISE
<50	36	30	-	-
50 to 100	48	21	-	-
100 to 150	60	18	-	-
150 to 200	60	16	-	-
200 to 600	72	--	36	36

*1 Weight of equipment and package or containers.
*2 Dimension along any edge or diameter.

b. Vibration

Vibration shall be sinusoidal in any direction with the frequency and amplitude specified in Table 3.2.

TABLE 3.2

VIBRATION

WEIGHT* (pounds)	5.0 to 26.5 cps	26.5 to 52.0 cps (inch DA)	52.0 to 500.0 cps
<50	±1.56g	0.048	±6.0g
50 to 300	±1.30g	0.036	±5.0g

*Weight of equipment and package or containers.

3.2.2 Use Point Prelaunch Environments

3.2.2.1 Induced, Block II (Reference 4)

These requirements represent the induced environmental design criteria for the equipment both in operating and nonoperating conditions. These induced environments are entirely controlled.

a. Temperature

+60°F. to 80° F. for up to 3 years.

+52°F. to 105°F. for 1 hour maximum.

b. Humidity

30 to 70 percent for up to 3 years.

c. Oxygen Atmosphere

95 ± 5 percent by weight oxygen at total pressures up to 14.7 psia for up to 24 hours. Oxygen partial pressure up to 14.7 psia coincident with total pressure up to 21.0 psia for 2 hours.

3.3 FLIGHT ENVIRONMENTS

The environmental conditions specified herein are applicable to the LEM and Block II equipment, and apply to the mission phases specified in Table 3.3. In any mission phase, various combinations of environments specified in Table 3.3 can occur simultaneously with the exception of shock and acceleration.

3.3.1 Acceleration

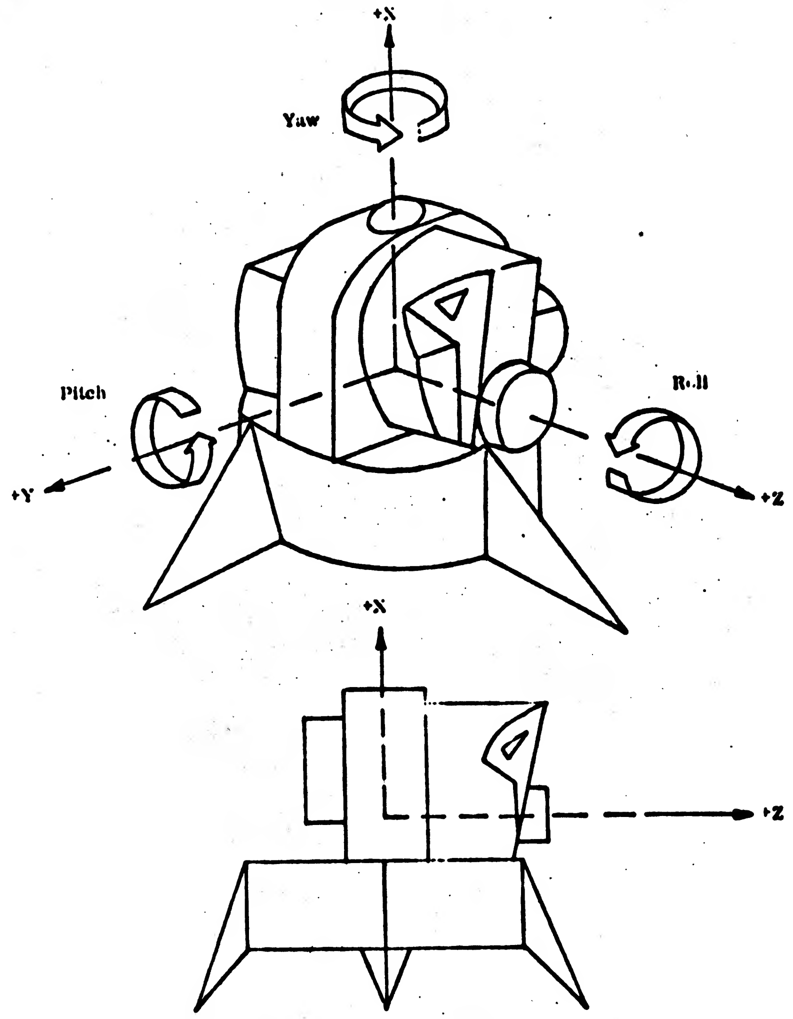
The following accelerations are applicable for the mission phases of Table 3.3. The LEM X, Y and Z reference axes shall be as defined by Figure 1.a, and Block II as defined by Figure 1b.

a. **Launch and Boost:** (References 4 and 7)

LEM X Axis:	+4.9, -1.7g	Envelope of maximum values. See Figure 2 for time history.
LEM Y Axis:	±0.40g	
LEM Z Axis:	±0.40g	
Block II X Axis:	6.0 g	

TABLE 3.3

ENVIRONMENT	LAUNCH & BOOST	LAUNCH ABORT	TRANSLUNAR SPACE	LUNAR DESCENT	LUNAR ASCENT	ENTRY
Acceleration	3.3.1.a	3.3.1.h	3.3.1.b	3.3.1.c	3.3.1.d	3.3.1.g
Shock			3.3.2.a	3.3.2.b	3.3.2.c	3.3.2.d
Vibration	3.3.3.a	3.3.3.e	3.3.3.b	3.3.3.c	3.3.3.c	3.3.3.d
Pressure	3.3.4.a		3.3.4.b	3.3.4.c	3.3.4.c	3.3.4.e & f
Humidity	3.3.5	→	→	→	→	→
Temperature	3.3.6.1.6 3.3.6.2.4	→	→	→	→	→
Corrosive Contaminants	3.3.7	→	→	→	→	→
EMI	3.3.8	→	→	→	→	→



LEM REFERENCE AXES

FIGURE 1.a

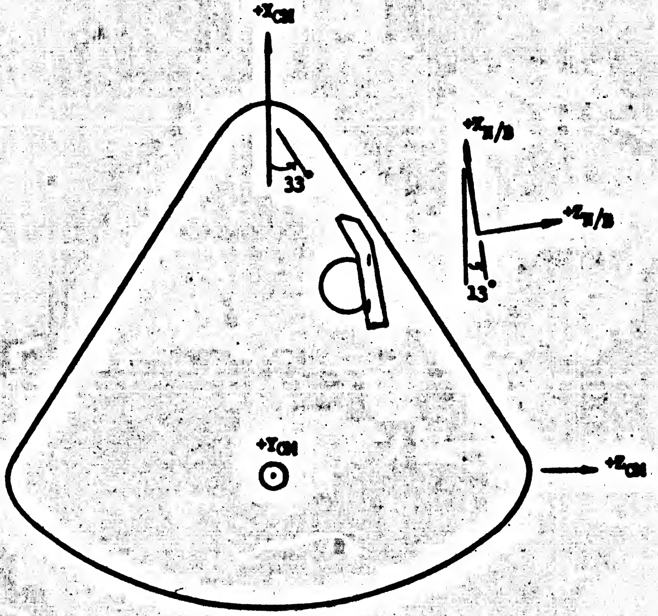
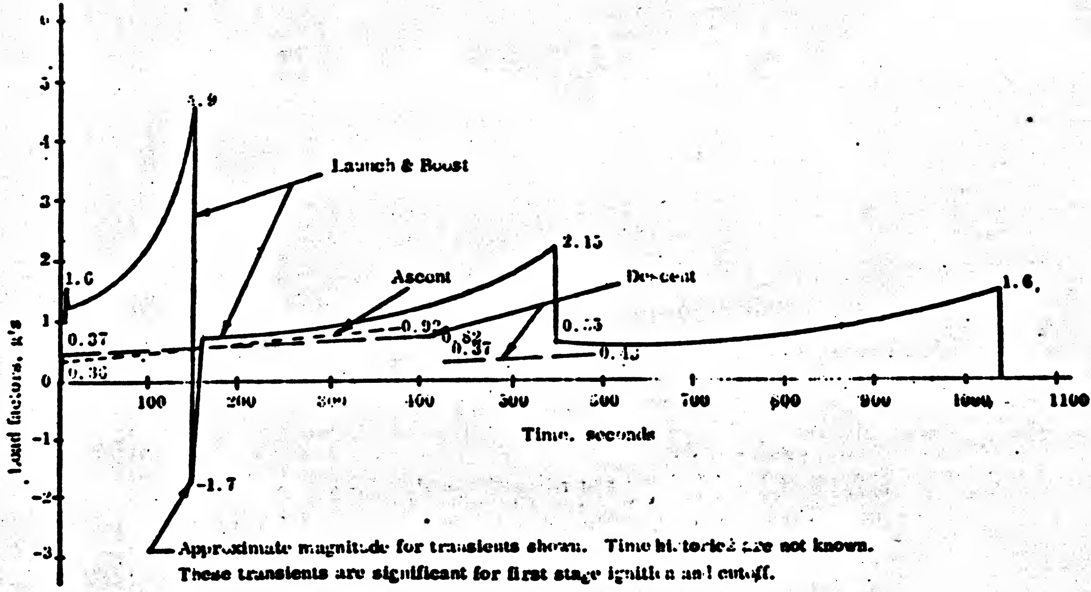


FIGURE 1.b

CM REFERENCE AXES



Approximate magnitude for transients shown. Time histories are not known. These transients are significant for first stage ignition and cutoff.

ACCELERATION, TIME HISTORY

FIGURE 2

b. **Translunar Space:**

X Axis: (-0.36g LEM) (+0.36g Block II)
Y Axis: ±0.062 g
Z Axis: ±0.062 g

Assume constant for duration of 6 minutes for translational acceleration.

c. **Lunar Descent, LEM:**

X Axis: +0.82 g
Y Axis: ±0.08 g
Z Axis: ±0.08 g

Assume constant for duration of 6 minutes for translational accelerations.

d. **Lunar Ascent, LEM:**

X Axis: +0.70 g
Y Axis: ±0.04 g
Z Axis: ±0.04 g

Assume constant for duration of 6 minutes for translational accelerations.

e. **Zero g Condition, LEM and Block II:**

No rotational or translational acceleration about any axis.

f. **Lunar Stay, LEM:**

One-sixth g condition, vehicle at rest on lunar surface.

g. **Entry, Block II:**

X Axis: +20 g 30 second duration

h. **Launch Abort, Block II:**

X Axis: +20 g 10 seconds duration

3.3.2 **Shock (References 4 and 7)**

|← The following shock magnitudes are applicable for the mission phases of Table III. The shocks shall be applied at the center of gravity of any item or equipment.

a. **Translunar Space, LEM:**

X Axis: -0.052g
Y Axis: +0.065g
Z Axis: ±0.065g

Preliminary. Time history to be supplied when available.

b. **Lunar Landing, LEM:**

The time history of the following shock magnitudes is shown in Figure 3.a. The shock magnitudes are based on a rigid LEM with flexible landing gear and a 1.6 magnification factor.

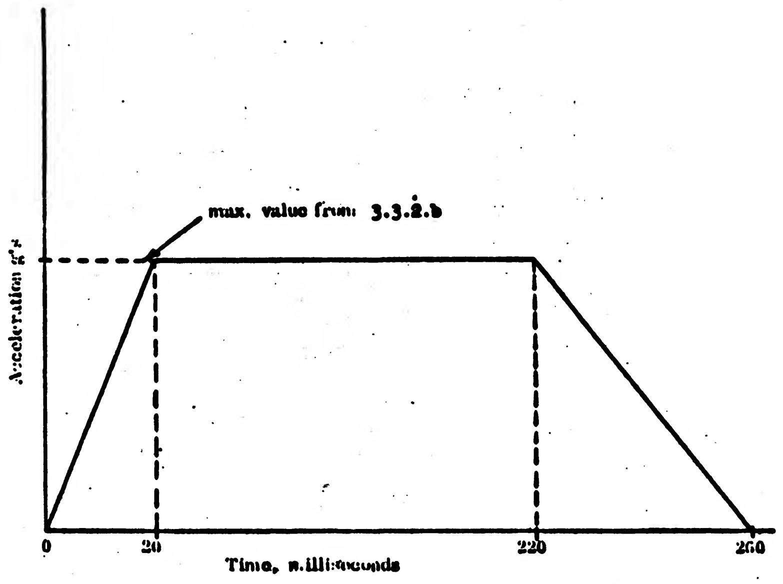
X Axis: +8.0 g
Y Axis: ±8.0 g
Z Axis: ±8.0 g

c. **Docking, LEM and Block II:**

Docking condition and time history to be supplied when available.

d. **Earth Landing, Block II:**

Terminal peak saw-tooth pulse of 78g (peak amplitude) with total duration 10 to 15 milliseconds, including decay time on greater than 10 percent of the total duration. The GN&C shall cause no hazard to the crew as a result of this shock. Figure 3.b defines the acceleration.



LUNAR LANDING

SHOCK MAGNITUDE TIME HISTORY

FIGURE 3.a

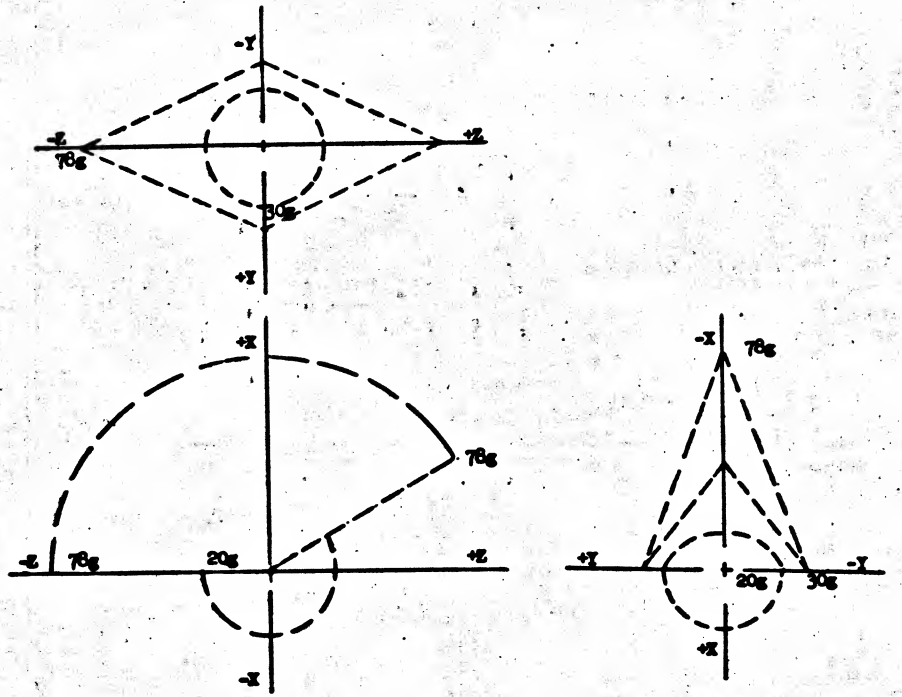


FIGURE 3.b Internal Equipment Ultimate Design Accelerations

3.3.3 Vibration

The following vibration levels and rates shall be applied by the LEM primary structure, including panels, to the G&N equipment supports, and by the CM to the Block II equipment along each of the three mutually perpendicular axes.

a. Launch and Boost

LEM (Reference 7)

Input to Equipment Supports from Exterior Primary Structure
(Use for IMU, AOT, DSKY, NVB, PTA, Wiring Harness "B")

Random: Applied for 5 minutes per axis.

10-23 Hz	12 db/octave rise to 0.0148 g^2/Hz
23-80 Hz	0.0148 g^2/Hz
80-110 Hz	12 db/octave rise to 0.0444 g^2/Hz
110-950 Hz	0.0444 g^2/Hz
950-1200 Hz	12 db/octave rolloff to 0.0148 g^2/Hz
1200-2000 Hz	0.0148 g^2/Hz

Sinusoidal: Swept at a rate of 3 octaves per minute, 5 to 100 Hz to 5 Hz continuous sweep, 0.154 inch double amplitude from 5 to 18.5 Hz, 2.69g from 18.5 to 100 Hz.

Input to Equipment Supports from Interior Primary Structure
(Use for LGC, CDU, PSA/SCA, Wiring Harness "A")

Random: Applied for 5 minutes per axis.

10-23 Hz	12 db/octave rise to 0.0148 g^2/Hz
23-80 Hz	0.0148 g^2/Hz
80-100 Hz	12 db/octave rise to 0.0355 g^2/Hz
100-1000 Hz	0.0355 g^2/Hz
1000-1200 Hz	12 db/octave rolloff to 0.0148 g^2/Hz
1200-2000 Hz	0.0148 g^2/Hz

Sinusoidal: Swept at a rate of 3 octaves per minute, 5 to 100 Hz to 5 Hz continuous sweep, 0.154 inch double amplitude from 5 to 16 Hz, 1.92g from 16 to 100 Hz.

During the launch and boost phase of flight, the LEM is exposed to random vibration of varied levels and spectra for 17 minutes. During all but approximately 2.5 minutes of this period, the intensity of the random vibration is of such a low level that it is considered to be of negligible design significance. In addition, the launch and boost environment is considered to include peak vibration levels which are represented by the above sinusoidal vibration envelopes. The number of sinusoidal peaks for design may be considered to be 1 percent of the natural frequency of the equipment and its supporting structure times the number of seconds exposure. For design purposes, the above random spectrum and sinusoidal levels applied separately for 5 minutes along each of the three mutually perpendicular axes X, Y and Z are considered to adequately represent the vibration environment. Grumman will supply the influence coefficients of the navigation base supporting the IMU. All other equipment is effectively mounted on primary structure.

Block II (Reference 4)

Input to Equipment

Random:	10-80 Hz	3 db/octave rise to 0.06 g^2/Hz
	80-400 Hz	0.06 g^2/Hz
	400-2000 Hz	3 db octave rolloff

Time Duration: See Figure 4.

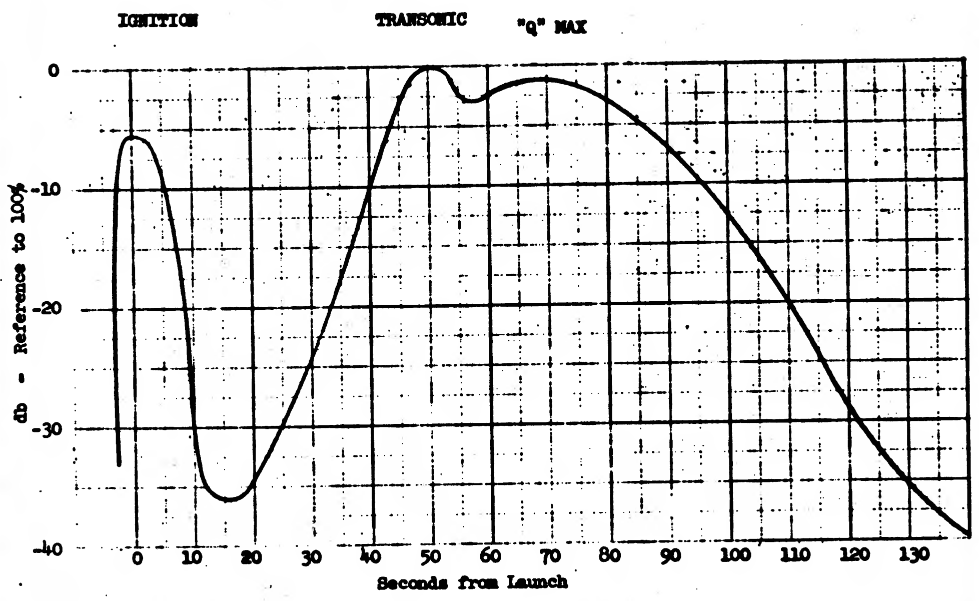


FIGURE 4

VIBRATION TIME HISTORY

b. Translunar Space

Inputs to Block II Equipment (Reference 4)

Random:	20-100 Hz	3 db/octave rise to 0.005 g^2/Hz
	100-2000 Hz	0.005 g^2/Hz

Time Duration: 12.5 minutes.

c. Lunar Descent and Ascent

Inputs to LEM Ascent Stage Equipment (Use for all equipment.) (Ref. 7)

Random: Applied for 21 minutes per axis.

10-20 Hz	12 db/octave rise to 0.0201 g^2/Hz
20-100 Hz	0.0201 g^2/Hz
100-120 Hz	12 db/octave rolloff to 0.010 g^2/Hz
120-2000 Hz	0.010 g^2/Hz

Sinusoidal: Swept at a rate of 0.5 octave per minute, 1 sweep from 5 to 100 Hz to 5 Hz, 5 through 17 Hz 0.10 inch double amplitude, 17 to 100 Hz 1.54g.

Inputs to Navigation Base Assembly (NVB):

The following vibration environments are the current best estimates for mission or operational simulation. These represent the calculated response near the LEM navigation base due to anticipated engine oscillatory thrust using current LEM modes. They may be utilized as inputs from the NBS (Navigation Base Support) to the NVB (Navigation Base) for purpose of performance evaluation, not for structural design.

Linear Vibration:

Lunar Descent:	20-30 Hz	20 db/octave increase to 0.003 g^2/Hz
	30-50 Hz	0.003 g^2/Hz
	50-86 Hz	30 db/octave decrease to 0.001 g^2/Hz
	86-2000 Hz	0.001 g^2/Hz

Lunar Ascent:	20-100 Hz	0.005 g^2/Hz
	100-136 Hz	20 db/octave increase to 0.00025 g^2/Hz
	136-184 Hz	0.00025 g^2/Hz
	184-240 Hz	30 db/octave decrease to 0.00001 g^2/Hz
	240-2000 Hz	0.00001 g^2/Hz

d. Entry

Inputs to Block II Equipment (Reference 4)

Random:	10-80 Hz	3 db/octave rise to 0.006 g^2/Hz
	80-400 Hz	0.006 g^2/Hz
	400-2000 Hz	3 db/octave rolloff

e. Launch Abort

Inputs to Block II Equipment (Reference 4)

Random: Vibration applied for 10 seconds

	10-80 Hz	3 db/octave rise to 0.06 g^2/Hz
	80-2000 Hz	0.06 g^2/Hz

3.3.4 Pressure

a. Launch and Boost

LEM (Reference 7) (See Figure 5)

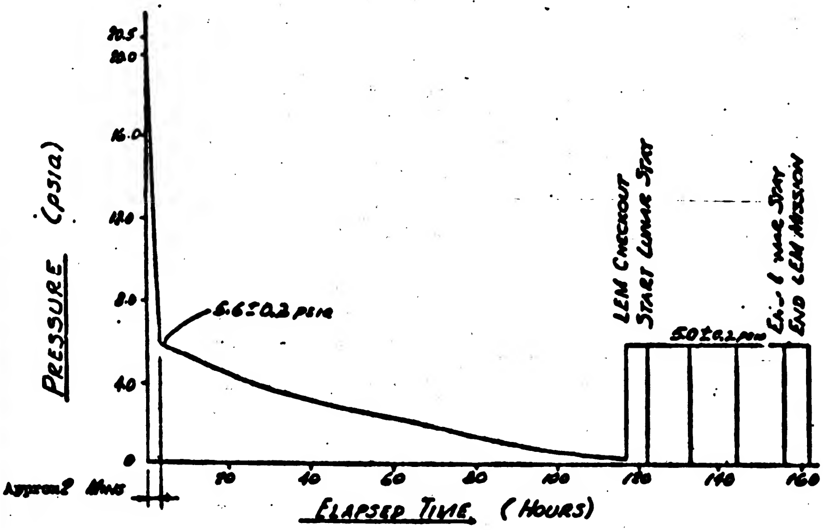
Cabin environment varies from 20.5 psia pressure at sea level to 5.4 psia (O_2).

Equipment Outside the Crew Cabin: Atmospheric pressure at sea level to

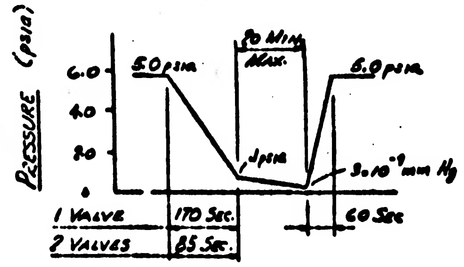
1×10^{-8} mm Hg (N_2).

Block II (Reference 4)

CM Interior: 14.7 psia nominal decreasing to 6.0 psia.



LEM CREW COMPARTMENT ENVIRONMENT
PRESSURE VS. ELAPSED TIME



NOMINAL BLOW-DOWN & RECOMPRESSION TIME

FIG 5

b. Translunar Space

LEM (Reference 7)

Cabin environment from 4.8 to 5.2 psia controlled cabin (O_2); 5.8 psia to 0.1 psia uncontrolled cabin (O^2).

Equipment between the heat shield and the crew cabin: 1×10^{-10} mm Hg uncontrolled vacuum.

Equipment outside heat shield: 1×10^{-14} mm Hg (Space)

Block II (Reference 4)

CM Interior: 6.0 psia decreasing to 5.0 psia (parking orbit only); 5.0 ± 0.2 psia (normal) for 336 hours; 1.0×10^{-4} mm Hg (emergency and during EVA) for 100 hours.

c. Lunar Descent and Ascent

LEM (Reference 7)

Cabin environment from 4.8 to 5.2 psia controlled cabin (O_2).

Equipment between the heat shield and the crew cabin: 1×10^{-10} mm Hg uncontrolled vacuum.

Equipment outside the heat shield: 1×10^{-12} mm Hg (uncontrolled vacuum on surface of moon).

d. Lunar Stay

LEM (Reference 7)

Cabin environment from 4.8 to 5.2 psia controlled cabin (O_2); 3×10^{-9} mm Hg cabin (hatch open) hatch open condition exists for a maximum of 20 minutes for each opening. Design for a total of 4 repressurizations.

Equipment outside the crew cabin: 1×10^{-10} mm Hg uncontrolled vacuum.

e. Entry

Block II (Reference 4)

5.0 psia increasing to 5.5 psia (nominal).

f. Earth Descent

Block II (Reference 4)

5.5 psia (nominal)increasing to 14.7 psia (nominal).

3.3.5 Humidity

3.3.5.1. LEM (Reference 7)

Humidity products are composed mainly of perspiration and breath moisture. Minor amounts are due to water escaping from the reconstitution of food systems and outgassing of materials. The following environments apply as shown:

All Equipment Within Crew Cabin	All Equipment Outside Crew Cabin	Time (Max)
1) None	None *	4.8 hrs
2) 40-70% - Controlled Cabin	None	2.5 hrs
0-100% - Uncontrolled Cabin	None	117.5 hrs
3) 40-70% - Controlled Cabin	None	48.0 hrs
0-100% - Locally in Cabin	None	

* Dry Nitrogen Purge just prior to launch.

3.3.5.2 Block II (Reference 4)

Zero to 100% relative humidity for 336 hours, including conditions where condensation takes place in the form of water or frost.

3.3.6 Thermal Environments

The Guidance and Navigation equipment shall be capable of proper operation in the thermal environments while being cooled by the environmental control subsystem. The thermal design requirements and interfaces will be specified herein. The thermal control of the Guidance and Navigation (G&N) equipment is, in general, based on an active thermal control system wherein the equipment is conductively coupled to a coolant which must be capable of accepting all of the internally dissipated power and environmental heat inputs. The coupling of the actively cooled G&N equipment to the coolant loop will be accomplished by either integral cooling lines or attachment of the equipment to cold plates. Low power level equipment will be cooled passively.

3.3.6.1 LEM (Reference 6)

a. Integral Cooling

The Inertial Measurement Unit (IMU) will be cooled by permanently affixed cooling lines which are attached to the LEM ECS loop by quick disconnects.

b. Cold Plate Cooling

The LEM Power and Servo Assembly (LPSA), Coupling Display Units (CDU), LEM Guidance Computer (LGC) and Pulse Torque Assembly (PTA) will be cooled by the attachment of their heat sink surfaces to Grumman supplied cold plates.

c. Passive Cooling

The LEM Display and Keyboard (DSKY) and Alignment Optical Telescope (AOT) shall be passively cooled.

d. Cooling Parameters

The thermodynamic properties and requirements of the LEM environmental control subsystem for the three types of G&N equipment are as specified herein.

e. Coolant Properties

The approximate chemical composition and the physical properties of the LEM environmental control coolant will be as follows. The coolant will be approximately 35% ethylene glycol ($HOCH_2CH_2OH$) and 65% water (H_2O) by weight with Triethanclamine phosphate (TRAP) and Sodium mercaptobensothlosol (NaMCBT) inhibitors.

3.3.6.1.1 Integral Cooling Lines

a. Coolant Flow Rates

The mass flow rate of the environmental control coolant to the IMU cooling loop during manned phases of mission will be 33 ± 5 pounds per hour. During unmanned translunar flight, there will be no coolant flow to the IMU.

b. Coolant System Pressure

The maximum design operating pressure for the coolant loop shall be 60 psig. The design proof pressure shall be 90 psig.

c. Coolant Pressure Drop

The maximum pressure drop through the IMU cooling loop including both halves of the disconnects shall be between 0.3 psi and 0.4 psi at a coolant flow rate of 33 lb/hr and inlet temperature of 40°F.

d. Coolant Temperature Variations

The inlet coolant temperature variations for the IMU will vary from 32°F to 50°F.

3.3.6.1.2 Cold Plate Cooling

a. Coolant Flow Rate

The LGC, CDU and LPSA cold plates are connected in series in the ECS loop. The flow rate to the LGC, CDU and LPSA coolant loop will be 33 ± 5 lb/hr. The flow rate to the PTA cold plate will be 33 ± 5 lb/hr. During unmanned translunar flight, there will be no coolant flow to the PGNS equipment cold plates.

b. Coolant Temperature Variations

The inlet coolant temperature to the LGC, CDU and LPSA coolant loop during manned phases of the mission will be 32°F. to 50°F.

c. Interface Conductance

For design purposes, the thermal gradient across the interface between the equipment heat sink surface and the environmental control coolant shall be assumed to be five (5) °F. for every watt per square inch of power dissipated to the cold plates.

3.3.6.1.3 Leakage Rate

The maximum leakage from the integrally cooled G&N equipment shall be as specified herein.

a. **Integral Heat Exchangers**

The maximum allowable leakage for each MIT supplied heat exchanger, including all permanent joints and all seals, shall be 5 x 10^{-6} std. cc/sec. of helium at 77.5 psig.

b. **Disconnects**

The maximum leakage for each disconnect in the fully connected condition shall be 12 x 10^{-8} std. cc/sec. of helium at 77.5 psig.

3.3.6.1.4 Passive Cooling

The Display Panel and AOT must be capable of operating in the environments specified in 3.3.6.1.6.a and 3.3.6.1.6.b. In addition, the AOT must be capable of accepting a maximum heat load of 9 watts from the LEM Abort Sensor Assembly when the AOT is at 0°F.

3.3.6.1.5 Surface Characteristics

Equipment surfaces shall conform to the following requirements.

a. **Surface Temperatures**

The temperatures of the external surfaces of actively cooled G&N equipment shall not exceed 120°F. during any portion of the vehicle mission.

b. **Surface Coatings**

The surface coatings required for the actively and passively controlled G&N equipment are as follows:

Actively Cooled Equipment: External surfaces, with the exception of heat sink surfaces, of the LGC, CDU, LPSA and PTA shall have an infrared emittance of 0.40 or less in the region of the electromagnetic spectrum between 5 microns and 35 microns.

Passively Cooled Equipment: Surfaces of the display panel and the AOT exposed to the interior of the LEM vehicle shall have an infrared emittance of at least 0.9 in order to be compatible with the environment of 3.3.6.1.6.a.

3.3.6.1.6 Thermal Environment

The thermal interchange of the G&N equipment with the surroundings will be to the extent specified herein.

a. Radiant Interchange with LEM Vehicle

The temperature of the surfaces in radiant contact with the PGNS equipment will vary from 0°F. to 130°F. during unmanned translunar flight, and from 0°F. to 160°F. during manned phases of the mission.

b. Conductive Interchange with the LEM Vehicle

The LGC, CDU, LPSA, PTA and their cold plates will be conductively isolated from LEM structure. The conduction resistance between the IMU and its mounting structure shall be 1.4°F/watt or greater. The temperature of the IMU mounting structure shall be 0°F. to 130°F. during unmanned translunar flight, and 0°F. to 160°F. during manned phases of the mission

3.3.6.1.7 Equipment Power Dissipation

The maximum average power dissipation for the G&N equipment is as follows:

LGC - 100 watts - Operate Mode
10 watts - Standby Mode

CDU - 68 watts

LPSA - 110 watts - IMU in Operate Mode
18 watts - IMU in Standby Mode

PTA - 79 watts

Displays - 19 watts

AOT - 15 watts

IMU - 113 watts - Operate Mode
44 watts - Standby Mode

3.3.6.2 Block II (Reference 5)

3.3.6.2.1 Coolant Characteristics and Requirements

a. Composition

The following coolant composition shall be used in the spacecraft liquid coolant loop. The applicable procurement specification is NAA MB 0110-006.

Glycol per MIL-E-7500

Triple Distilled Water

Basic Solution composed of: 62.500 parts by weight of glycol
37.422 parts by weight of water
1.563 parts by weight of Inhibitor No. 1 - Triathanolamine phosphate (TEAP)
0.156 parts by weight of Inhibitor No. 2 - Sodium mercaptobenzothiazol (NaMCBT)
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b. System Pressure

The maximum design operating pressure for the liquid coolant loop shall be 60 psig. The design proof pressure shall be 90 psig.

c. Temperature Variations

The lower, steady state temperature limit presently anticipated is 54°F., applicable to lunar orbit with minimum thermal load. This does not apply to the NBA; see page 31 for NBA temperature.

3.3.6.2.2 Navigation Base Assembly (NBA) Coolant Requirements

a. Steady State Inlet Temperature

The IMU steady state inlet temperature in all modes shall be 45 ± 10°F.

b. Flow Rate

33 lbs/hr ± 3 lbs/hr Nominal; Max Flow Rate, 48 lbs/hr; Min Flow Rate, 25 lbs/hr.

c. Pressure Drop

1.6 psi max., between input and output including flexible hoses and both halves of quick disconnects at 33 lbs/hr and inlet temperature of 45°F.

d. Inertial Measuring Unit (IMU)Thermal Load

The IMU incorporates an integral heat exchanger. The electrical loads imposed on the coolant loop are 100 watts max. avg. and 80 watts nom.

3.3.6.2.3 Allowable Leakage Rates, Navigation Base Assembly

a. Integral Heat Exchangers

The maximum allowable leakage for the MIT supplied integral heat exchanger including all permanent joints and all seals shall be 5×10^{-6} std. cc/sec of helium at 77.5 psig.

b. Quick Disconnects

Connected: The maximum leakage for each quick disconnect in the fully connected condition shall be 12×10^{-6} std. cc/sec of helium at 77.5 psig. Connecting: The maximum gaseous inclusion shall be 0.01 std. cu.in. of oxygen (0.16 cu.in.) per connector per connection. A maximum total of 10 connecting operations on the launch pad is assumed. Liquid leakage, if applicable, shall be as specified below.

Disconnecting: The maximum liquid leakage per connector per disconnect operation shall be 1/2 drop (0.0333 gm) of coolant. For pad operation, means shall be provided for collecting and removing from the spacecraft 100 percent of coolant leakage from such operations.

3.3.6.2.4 G&N Local Thermal Environments

a. IMU and CDUJB - Surrounding Structure

Design Temperature: 100°F. max
95°F. nom
60°F. min

Surface Emissivity: E = 0.8 max

b. PSA Support Structure

Design Temperature: 100°F. max
60°F. min

c. AGC Support Structure

Design Temperature: 95°F. max
60°F. min

d. Estimated Convection Coefficient

In-Flight: 0.15 to 0.20
Pre-Launch 0.75

3.3.7 Corrosive Contaminants

The following condition applies to the CM interior. Salt atmosphere as caused by human perspiration, the effect of which is simulated by exposure to a 1% salt solution by weight for 48 hours.

3.3.8 Electromagnetic Interference

3.3.8.1 LEM (Reference 7)

a. Radio Frequency

Background radio frequency radiation levels shall not exceed the susceptibility limits specified in Specification MIL-I-26600/MSC-ASPO-EMI-10A.

b. Power Supply Transients and Ripple

The LEM equipment shall be capable of operating with power line transient voltages of +50 volts and -100 volts maximum amplitude, having a duration of 10 μ sec and a repetition rate of 10 pps, and shall be capable of operating with power line ripple voltage of ±1.5 volts peak having frequency components from 20 cps to 20 kc. The transient and ripple voltages are superimposed on the steady state power line voltage.

3.3.8.2 Block II Electromagnetic Capability

No Requirements

4. TEST REQUIREMENTS

4.1 GENERAL

This section establishes the qualification test requirements for all LEM and Block II G&N equipment. Qualification tests shall consist of exposure of production hardware to the specified environmental conditions to assure that it shall meet the design requirements and perform its intended mission function. During the environmental exposures, the equipment shall be operative or nonoperative, depending on its condition during actual mission encountered environments. Both natural and induced environments are included in the test programs. The test articles subjected to qualification tests shall (1) be manufactured with the same tooling processes, quality control procedures, and (2) be representative of the same design as normal production units destined for flight equipment.

4.1.1 Prior Compliance

The Apollo G&N equipment shall have successfully met all requirements of the applicable inspection and acceptance test requirements as delineated in the SCD (Specification Control Drawing), PS (Purchase Specification), or FTM (Final Test Method) prior to being submitted for qualification testing as defined in this specification. Data from the inspection and acceptance shall be recorded and shall form a part of the qualification test data.

4.1.2 Atmospheric Conditions

Unless otherwise specified, tests shall be performed at room ambient atmospheric pressure, a temperature of 73 ± 10°F., and a relative humidity of 80% maximum.

4.1.3 Instrumentation and Data

Instrumentation and data acquisition equipment shall be used to assure a sufficient data record of the environmental parameters controlled, and of the test article parameters critical to end item performance within the confinement of the testing facility. Additional parameters may be recorded as secondary data to assist in failure isolation, evaluation information, etc., at the discretion of the testing activity. Special care shall be taken to provide signal isolation and prevent circuit loading such that the data acquisition system has a minimum effect on equipment performance.

4.1.4 Failures

4.1.4.1 General

A failure occurs when the equipment under test is unable to perform its intended function within specified tolerances. Any failure shall be completely documented and reported utilizing the Apollo G&N failure reporting system. Formal qualification testing of the failed item shall be discontinued until the failure is resolved. Unless otherwise directed, when corrective action has been accomplished the test item shall be resubjected to the test phase where the failure occurred and the test sequence continued from that point. Changes in the absolute value of critical parameters will require individual evaluation prior to re-establishing a new measurement base. If, while the test item is being resubjected to a test phase, a totally unrelated failure occurs, it shall be reported, evaluated, and the proper corrective action accomplished; but it shall not be considered a qualification failure, and therefore, testing shall be continued from that point. At any point in the test program where corrective action results in replacement of a component, this component shall be considered qualified by similarity in all previous environmental exposures, unless failure analysis proves otherwise. If there is repeated failure, malfunction or out-of-tolerance performance in a given environment, this shall be recorded, analysis performed, and the equipment repaired and rechecked and them subjected to the next scheduled environment pending review and resolution with MIT and NASA representatives.

4.1.4.2 Failure of Test Facility

If the test facility fails, the equipment under test shall be rechecked and the test continued in the manner in which the test facility malfunction will result in a minimum effect upon the qualification of the equipment under test. Component failures induced by test facility failure shall be recorded, analyzed, and the component repaired, but shall not be considered relevant to G&N equipment qualification.

4.1.5 Reporting

System and subsystem qualification tests. interim reports are required at approximately monthly intervals. Final reports are required for each G&N part and equipment tested. Final reports shall be submitted to MIT/IL and NASA/MSC within 45 days following completion of the total test effort and at a minimum must include:

a. Test plan and procedure or a reference to this document.
b. Deviations from plan if any.
c. Acceptance data
d. Photos, diagrams, description, etc., of test articles and setups where significant or unique
e. Summary of failures and corrective action.
f. Test results
g. Test data and analyses
h. Conclusions

4.1.6 Examination of Equipment

The equipment shall be visually inspected for mechanical discrepancies before and after being subjected to each environmental exposure.

4.1.7 Test Conditions

The input excitation and output loading of the G&N system shall be in accordance with the applicable test plan. Cold plates shall be utilized per normal equipment installation and the coolant temperature flow rate shall be in accordance with the applicable test plan.

4.1.8 Performance

The test articles shall meet the requirements of the applicable test plan before, during where specified, and after exposure in each environment.

4.1.9 Witnessing Personnel

The NASA representative or his designated alternate shall be notified of all tests in advance of their scheduled performance.

4.1.10 Marking of Qualification Test Samples

All assemblies, subassemblies or piece parts which have been subjected to qualification testing on the Apollo Program and are being returned to productive divisions for repair or following the qualification test sequence and prior to final disposition of the test articles, all units and all reusable items removed from a unit shall be marked as follows:

a. Marking and Identification

All articles shall be marked with yellow characters 1/4 inch high. The words "QUAL TEST" shall be used to identify this type hardware.

b. Marking Location

Where feasible, location of marking shall be adjacent to the part number and readily visible from the assembled position. Those articles which cannot be marked due to size limitations shall be identified by tagging or bagging and marking the tag or bag.

c. Marking Application

Marking shall be accomplished utilizing ink which conforms to SCD 1006271-004.

4.2 TEST REQUIREMENTS

The LEM and Block II equipment to be subjected to the environments as shown in the following paragraphs are displayed in Table 4.1a. Items requiring requalification due to design changes are listed in Table 4.1b. The following Block II or LEM items have been or will be qualified as a result of the Block I Qualification Tests either directly or by similarity and need not be tested to the Block II environments, as specified herein.

Optical Unit Assembly
Optics Shroud Assembly
Eyepiece Storage Compartment
Bellows

4.2.1 Acceleration

The axes of application apply for all equipment except the inertial components of the Inertial Measurement Unit. For each operational environment, the inertial components are exposed to the acceleration shown in the $\pm X$, $\pm Y$ and $\pm Z$ inertial component axes. All six axes are qualified during each exposure provided the IMU is run inertial on a centrifuge.

4.2.1.1 LEM Acceleration

The LEM equipment shall be exposed to the environment in the following configurations:

	LEM								BLOCK II							
	SN	VIB	SHOCK	ACCEL	T/V	HUMIDITY	C.A.	GT	VIB	SHOCK	ACCEL	T/V	HUMIDITY	C.A.	GT	EMI
IMU	604 203	4.2.3.1 —	4.2.2.1 —	4.2.1.1 —	4.2.6.1 —	4.2.5 —	4.2.7 —	4.2.4 —	4.2.3.2 —	4.2.2.2 —	4.2.1.2.2 —	NOTE 1 —	NOTE 1 —	NOTE 1 —	NOTE 1 —	— 4.2.8
NAV BASE	604 605 203	— 4.2.3.1 —	— 4.2.2.1 —	4.2.1.1 — —	— 4.2.6.1 —	— 4.2.5 —	— 4.2.7 —	— 4.2.4 —	— — 4.2.3.2	— — 4.2.2.2	— — 4.2.1.2.2	— — 4.2.6.2	— — 4.2.5	— — 4.2.7	— — 4.2.4	— — 4.2.8
AOT	604	4.2.3.1	4.2.2.1	4.2.1.4	4.2.6.1	4.2.5	4.2.7	4.2.4	—	—	—	—	—	—	—	—
CCRD	604	4.2.3.1	4.2.2.1	4.2.1.4	4.2.6.1	4.2.5	4.2.7	4.2.4	—	—	—	—	—	—	—	—
PSA	604 203	4.2.3.1 —	4.2.2.1 —	4.2.1.1 —	4.2.6.1 —	4.2.5 —	4.2.7 —	4.2.4 —	— 4.2.3.2	— 4.2.2.2	— 4.2.1.2.2	— 4.2.6.2	— 4.2.5	— 4.2.7	— 4.2.4	— 4.2.8
SCA	604 203	4.2.3.1 —	4.2.2.1 —	4.2.1.4 —	4.2.6.1 —	4.2.5 —	4.2.7 —	4.2.4 —	— 4.2.3.2	— 4.2.2.2	— 4.2.1.2.2	— 4.2.6.2	— 4.2.5	— 4.2.7	— 4.2.4	— 4.2.8
PTA PEA	604 203	4.2.3.1 —	4.2.2.1 —	4.2.1.1 —	4.2.6.1 —	4.2.5 —	4.2.7 —	4.2.4 —	— 4.2.3.2	— 4.2.2.2	— 4.2.1.2.2	— 4.2.6.2	— 4.2.5	— 4.2.7	— 4.2.4	— 4.2.8
LGC/CMC		4.2.3.3	NOTE 1	4.2.1.3	4.2.6.1	4.2.5	4.2.7	4.2.4	NOTE 1	4.2.2.2	4.2.1.2.2	NOTE 1	NOTE 1	NOTE 1	NOTE 1	4.2.8
DSKY		4.2.3.3	NOTE 1	4.2.1.3	4.2.6.1	4.2.5	4.2.7	4.2.4	NOTE 1	4.2.2.2	4.2.1.2.2	NOTE 1	NOTE 1	NOTE 1	NOTE 1	4.2.8
CDU	604 203	4.2.3.3 —	NOTE 1 —	4.2.1.1 —	4.2.6.1 —	4.2.5 —	4.2.7 —	4.2.4 —	NOTE 1 —	4.2.2.2 —	4.2.1.2.2 —	NOTE 1 —	NOTE 1 —	NOTE 1 —	NOTE 1 —	— 4.2.8
GNIC	203	—	—	—	—	—	—	—	4.2.3.2	4.2.2.2	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	4.2.8
HARNESS	604 203	4.2.3.1 —	4.2.2.1 —	4.2.1.1 —	4.2.6.1 —	4.2.5 —	4.2.7 —	4.2.4 —	— 4.2.3.2	— 4.2.2.2	— 4.2.1.2.2	— 4.2.6.2	— 4.2.5	— 4.2.7	— 4.2.4	— 4.2.8
HOSE	203	—	—	—	—	—	—	—	4.2.3.2	4.2.2.2	4.2.1.2.2	4.2.6.2	4.2.5	4.2.7	4.2.4	—
OUA	201A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4.2.8

NOTE 1 - THE COMPONENTS IDENTIFIED BY THIS NOTE WILL BE QUALIFIED IN A COMBINED LEM/BLOCK II ENVIRONMENT.

QUALIFICATION OF LEM AND BLOCK II EQUIPMENT

TABLE 4.1b

UNIT	ENVIRONMENTS							
	VIB	SHOCK	ACCEL	T/V	HUM	CA	GT	EMI
Pulse Torque Power Supply	4.2.3.3	4.2.2.2	4.2.1.3 4.2.1.2.2	4.2.6.1	4.2.5	4.2.7	4.2.4	NR

QUALIFICATION OF LEM AND BLOCK II EQUIPMENT

a. The IMU on the navigation base together with a dummy ASA and dummy AOT mounted on it. The PSA with a dummy SCA mounted on it. Airborne cold-plates will be mounted to the PSA, PTA, and CDU. The A and B harnesses will interconnect the units insofar as possible. All units will be tested at the same time and the acceleration input will be measured to the center of gravity of the IMU.

b. The AOT/CCRD will be tested as a single unit and the acceleration input will be measured to the center of gravity of the combined unit.

c. All other units may be tested separately with the input measured to the center of gravity of the test sample.

d. Nominal coolant temperature/flow rate will be used.

4.2.1.1.1 LEM Launch Acceleration

Acceleration: 6.0 ± 1.0g
Duration: 5 minutes
Axes: +X, ±Y, ±Z LEM
Condition: Nonoperational

4.2.1.1.2 LEM Lunar Descent and Ascent Equipment Evaluation Acceleration

Acceleration: 3.0 ± 0.5g
Duration: 5 minutes
Axes: +X, ±Y, ±Z LEM
Condition: Operational

4.2.1.1.3 LEM Lunar Landing Shock Acceleration

Acceleration: 10.0 ± 1.0g
Duration: 15 to 30 seconds
Axes: +X, ±Y, ±Z LEM
Condition: Operational

4.2.1.2 Block II Acceleration

The Block II equipment shall be exposed to the following environments as follows:

a. The IMU will be mounted on the navigation base with a dummy OUA. The IMU, navigation base, PSA (with dummy SCA), PEA, CDU, and GNIC Panel will be tested at the same time, interconnected with the G&N harness, with the acceleration input measured to the center of gravity of the IMU.

b. All other units may be tested separately with the input measured to the center of gravity of the test sample.

4.2.1.2.1 Block II Launch Acceleration

Acceleration: 6.0 ± 1.0g
Duration: 5 minutes
Axis: +X CM
Condition: Operational

4.2.1.2.2 Block II Launch and Entry Abort Acceleration

Acceleration: 18 +1, -0.5g
Duration: 5 minutes
Axis: +X CM
Condition: Operational

4.2.1.3 LEM and Block II Combined Acceleration

The LGC/CMC and DSKY may be tested separately with the acceleration input measured to the center of gravity of the test sample. LEM cold plates will be used.

Acceleration: 10 ± 1.0g
Duration: 5 minutes
Axis: +X, ±Y, -Z LEM
Condition: Operational

4.2.1.4 LEM Combined Acceleration

The AOT/CCRD will be tested as a single unit. The LEM SCA will be tested on a dummy PSA. The acceleration input will be measured to the center of gravity of the test sample.

Acceleration: 10 ± 1.0g
Duration: 5 minutes
Axis: +X, ±Y, ±Z LEM
Condition: AOT/CCRD Nonoperational
LEM SCA Operational

4.2.2 Shock

Shock tests shall be performed as follows using Standard MIL-STD-810, Method 516.1 as a guide. Unless otherwise specified the shock level tolerance shall be ±10 percent and time duration tolerance ±10 percent. In the event that the shock test is conducted utilizing a vibration exciter and the tolerance limits specified above cannot be met, these limits may be broadened to account for the exciter dynamics; however, overshoot shall not exceed 75 percent of the peak g value. Shock will be performed in the same configuration as vibration, except dummies may be substituted for airborne components for earth landing shock.

4.2.2.1 LEM Lunar Landing and Flight Shock

The LEM equipment shall be exposed to one shock along each plus and minus direction of each of three orthogonal axes (6 shocks). Shocks shall be:

Magnitude: 10g minimum
Duration: 15 to 20 milliseconds
Shape: Terminal Peak Sawtooth
Condition: Operational

4.2.2.2 Block II Shock

4.2.2.2.1 Block II Flight Shock

The Block II equipment shall be exposed to one shock along each plus and minus direction of each of three orthogonal axes (6 shocks). Shocks shall be:

Magnitude: 20g
Duration: 6 milliseconds
Shape: Terminal Peak Sawtooth
Condition: Operational

4.2.2.2.2 Block II CM Earth Landing Shock

The Block II equipment shall be exposed to one shock each in the +X and +Z direction (2 shocks). Dummy equipment may be used for this test provided the actual equipment mounting configuration is simulated. Mounting provisions may be replaced between shocks.

Magnitude: 78g
Duration: 11 milliseconds
Shape: Terminal Peak Sawtooth
Condition: Nonoperational

4.2.3 Vibration

Vibration tests shall be conducted in accordance with the following paragraphs of Standard MIL-STD-810, Method 514.1; Procedure 1, Random Vibration; Control and Analysis of Random Vibration paragraph 5.3, Vibration Input Control paragraph 9.4, and Transducer Mounting paragraph 9.4 of Section 9 entitled Test Details and Techniques. Tolerance limits between 10 and 50 Hz shall be ±3 db. In the event the ±1.5 db from 50 to 1000 Hz cannot be met with existing facilities, the tolerance may be broadened to ±3 db providing the overall g rms level is held to ±10 percent. If a multiple band pass random equalizer is used to develope the input spectra, these tolerances apply only to the center frequencies of the filters for rollup or rolloff.

The random vibration shall be Gaussian distributed with the exception that magnitude limiting shall occur at a 3 to 1 peak-to-rms acceleration ratio. The spectra are defined by the straight line connections of the given coordinates on log-log graph paper.

All equipment exposed to the nonoperational condition shall have all power, coolant, etc., off (except IMU heater power). At a minimum, a short on-site performance check shall be conducted following each axis of vibration. The operational equipment shall be exercised and functionally checked as thoroughly as possible during the exposure. Recording instrumentation shall be provided where applicable to monitor equipment performance. For assembled configurations, dummies may be used for equipment not being qualified during a particular test run.

4.2.3.1 LEM Launch and Lunar Phase Vibration

The LEM equipment, excluding the ECDU, LGC and DSKY, shall be subject to the LEM Launch and Lunar Phase Vibration spectra along three orthogonal axes. The equipment is defined as follows:

LEM Navigation Base, Mounted on the Navigation Base Support, with IMU, AOT/CCRD, RGA and ASA.	Assembled with input to Navigation Base Support Mounting Points.
PSA and SCA with cold plate. PTA with cold plate.	Assembled with input to Cold Plate Mounting Points
Harnesses A and B	Input to Holding Fixture

4.2.3.1.1 LEM Launch Vibration

The LEM Launch Vibration is given below by two spectra. The first spectrum applies to the Navigation Base Assembly, Harnesses A and B, and the PTA; and the second applies to the PSA/SCA Assembly.

Navigation Base Assembly, Harnesses A and B, and PTA Spectrum Coordinates:

12 db rollup from 10 Hz to

$0.025\ g^2/\text{Hz}$ at 23 Hz

$0.025\ g^2/\text{Hz}$ at 80 Hz

$0.075\ g^2/\text{Hz}$ at 110 Hz

$0.075\ g^2/\text{Hz}$ at 950 Hz

0.025 g^2/Hz at 1200 Hz

0.025 g^2/Hz at 2000 Hz

Time Duration: 5 minutes per axis

Equipment Condition: Nonoperational

PSA/SCA Spectrum Coordinates:

12 db rollup from 10 Hz to

0.025 g^2/Hz at 23 Hz

0.025 g^2/Hz at 80 Hz

0.060 g^2/Hz at 100 Hz

0.060 g^2/Hz at 1000 Hz

0.025 g^2/Hz at 1200 Hz

0.025 g^2/Hz at 2000 Hz

4.2.3.1.2 LEM Lunar Phase Vibration

LEM Equipment, excluding ECDU, LGC and DSKY Spectrum Coordinates:

12 db rollup from 10 Hz to

0.034 g^2/Hz at 20 Hz

0.034 g^2/Hz at 100 Hz

0.017 g^2/Hz at 120 Hz

0.017 g^2/Hz at 2000 Hz

Time Duration: 21 minutes

Equipment Condition: Operational

4.2.3.2 Block II Launch Vibration

The Block II CM equipment, excluding the ECDU, shall be subjected to the Block II Launch Vibration along three orthogonal axes. The equipment is defined as follows:

Navigation Base with IMU, Hose Assembly, and dummy Bellows and dummy OUA.	Assembled with Input to Navigation Base Mounting Points

PSA/SCA, PEA, GNIC Panel, and Harness Mounted on Cold Plates where applicable	Input to Equipment or Cold Plate Mounting Points

Spectrum Coordinates:

3 db rollup from 10 Hz to
0.06 g^2/Hz at 70 Hz
0.06 g^2/Hz at 420 Hz
3 db rolloff from 420 Hz to 2000 Hz
Time Duration: 6 minutes per axis
Equipment Condition: Operational, except OUA

4.2.3.3 ECDU, LGC/CMC, DSKY, and Launch and Lunar Phase Composite Vibration

The ECDU, LGC/CMC and DSKY shall be subjected to the following random vibration spectrum along three orthogonal axes. LEM cold rails shall be used.

Spectrum Coordinates:

3 db rollup to
0.06 g^2/Hz at 70 Hz
0.06 g^2/Hz at 1000 Hz
0.025 g^2/Hz at 1200 Hz
0.025 g^2/Hz at 2000 Hz
Time Duration: 12 minutes per axis
Equipment Condition: Operational

4.2.4 Ground Temperature

The ground temperature conditions are described herein. The test sequence may be interrupted between lettered steps to facilitate scheduling problems, etc.; however, it is desired to complete the total cycle once it has been initiated. Unless other wise specified, the temperature and pressure tolerances are ±5°F and ±0.5 psi. The rate of temperature change shall not exceed 30°F. per minute. The temperature shall be chamber air ambient temperature.

The G&N equipment shall be subjected to the ground temperature condition as indicated in Figure 6 and detailed below. During the exposure the equipment shall be operational during the specified times during which it shall be exercised as completely as possible and checked within the limits imposed by chamber confinement. At all other times all coolant, power, etc., including gyro suspension shall be off (IMU heater power shall be on to maintain platform temperature). If the test sequence is interrupted, the equipment shall be functionally checked prior to reinitiating the test sequence. The equipment shall be mounted on airborne coldplates where normally provided, which shall be attached to a mounting fixture conductively isolated from the coldplate except at the mounting points. Non coldplate mounted G&N equipment shall have a fixture equipment interface temperature of 0°F. minimum to 150°F. maximum.

a. 24 hours minimum at -20°F.
b. Raise temperature to +20°F. in one hour.
c. Stabilize at +20°F. for 4 hours.
d. Maintain +20°F. for duration of functional check (4 hour minimum).
e. Raise the temperature from +20°F. to +140°F +0, -5°F. in 2 hours.
f. Maintain +140°F +0, -5°F. for 24 hours.
g. Reduce the temperature to 107°F. in one hour and stabilize at 107°F for 4 hours.
h. Maintain 107°F. for duration of functional check (4 hours minimum).

4.2.4.1 Equipment Configuration

a. LEM - The IMU, Navigation Base, PSA, PTA, CDU on a LEM coldplate, and Harness will be exposed at the same time.

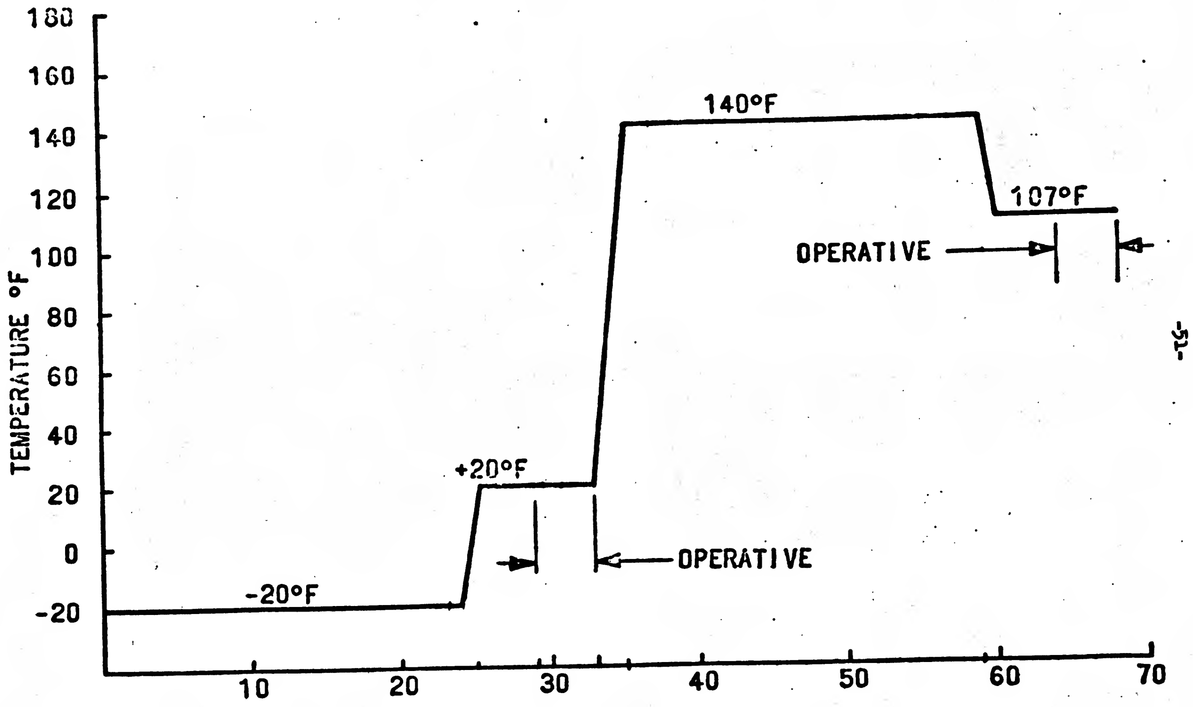
b. Block II - The PSA, Navigation Base, PTA, GNIC, Hoses, and as much of the harness as possible will be exposed at the same time. The support IMU and CDU will not be exposed.

c. The AOT/CCRD will be exposed as a single unit.

d. The LGC/CMC and DSKY will be exposed at the same time using LEM coldplates.

e. All other units may be exposed separately.

G&N SYSTEM OPERATIONAL CYCLE
GROUND TEMPERATURE



TIME-HOURS

Figure 6

4.2.5 Humidity Temperature

The humidity environment shall be five 24 hour humidity cycles in accordance with Method 507.1 of Standard MIL-STD-810 except the maximum temperature shall be 120°F. The temperature shall be raised from 70°F to 120°F in 2 hours, 120°F shall be maintained for 6 hours minimum and then the temperature shall be gradually reduced to 70°F over the next 16 hours.

The G&N equipment shall be subjected to the humidity test as indicated. During the test, the equipment shall be interconnected with the airborne harness insofar as possible, and operated in all equipment modes and exercised as thoroughly as possible except during the portion of each cycle where the temperature is above 105°F. During the portion of each cycle when the ambient temperature is above 105°F., the equipment shall be off, except for coolant flow and power required for normal heat, suspension, etc.

4.2.5.1 Equipment Configuration

a. LEM - The IMU, Navigation Base, PSA, PTA, CDU on a LEM coldplate, and Harness will be exposed at the same time.

b. Block II - The PSA, Navigation Base, PEA, GNIC, Hoses, and as much of the harness as possible will be exposed at the same time. The support IMU and CDU will not be exposed.

c. The AOT/CCRD will be exposed as a single unit.

d. The LGC/CMC and DSKY will be exposed at the same time using LEM coldplates.

e. All other units may be exposed separately.

4.2.6 Thermal Vacuum

The thermal vacuum conditions are described herein. Unless otherwise indicated the time of exposure to an environment does not include the time required to attain that environment. The test sequence may be interrupted between lettered steps to facilitate scheduling problems, etc.; however, it is desired to complete the total cycle once it has been initiated. Unless otherwise specified, the temperature and pressure tolerances are ±5°F and ±0.5 psi. The rate of air temperature change shall not exceed 30°F per minute and the rate of pressure change shall not exceed 5 psia per minute.

The G and N equipment shall be subjected to the thermal vacuum condition as indicated and as detailed herein. During the exposure the equipment shall be operational (except where specified) during which it shall be exercised as completely as possible and checked within the limits imposed by chamber confinement. At all other times all coolant, power, etc., including gyro suspension shall be off (IMU heater power shall be on to maintain platform temperature). If the test sequence is interrupted, the equipment shall be functionally checked prior to reinitiating the test sequence. The equipment shall be mounted on airborne coldplates where normally provided, which shall be attached to a mounting fixture conductively isolated from the coldplate except at the mounting points. Non coldplate mounted G and N equipment shall have a fixture equipment interface temperature of 0°F minimum to 150°F maximum. The equipment configuration shall be as specified in 4.2.4.1.

Definition of coldplate and heat exchanger conditions are as follows:

Nominal:	Nominal flow rate and input temperature.
Maximum:	Highest inlet temperature and lowest flow rate with the exception that the coldplate interface temperature shall be monitored and temperature and/or flow rate shall be varied to prevent the interface temperature from exceeding that specified in the applicable ICD.

Minimum: Lowest inlet temperature and highest flow rate.

Off: No coolant flow.

4.2.6.1 LEM Thermal Vacuum

The LEM G&N equipment shall be subjected to the conditions detailed herein. The space exposed portions of the AOT external to the meteor shield shall be tested to condition (o) simultaneously while the internal meteor shield and cabin portions are exposed to the LEM conditions (a) through (n), except the internal meteor shield portions shall be exposed to the space pressure conditions. The AOT shall be checked intermittently during long duration operational exposures. The equipment shall be operating unless otherwise stated.

(a) Air Temperature: 75°F
Pressure: 5.00 ± 0.25 psia
Cold Plate Condition: Nominal
Duration: 24 hours

(b) Wall Temperature: 75°F
Pressure: 1×10^{-4} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 12 hours

(c) Wall Temperature: Raise from 75°F to 150°F.
Pressure: Reduce from 1×10^{-4} mm Hg to 1×10^{-7} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 4 hours

(d) **Wall Temperature:** 150°F.
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 48 hours

(e) **Wall Temperature:** Reduce from 150°F to 0°F.
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 4 hours

(f) **Wall Temperature:** 0°F.
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: Nominal
Duration: 48 hours

(g) **Wall Temperature:** Raise from 0°F to 130°F.
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: From Nominal to Off
Duration: 4 hours

(h) **Wall Temperature:** 130°F.
Pressure: 1×10^{-7} mm Hg
Cold Plate Condition: OFF
Duration: 12 hours

(i) **Wall Temperature:** 160°F
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: Maximum
Duration: 12 hours

(j) Wall Temperature: Reduce from 160°F to 0°F
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: From Maximum to Off
Duration: 4 hours

(k) Wall Temperature: 0°F
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: Off
Duration: 12 hours
Equipment Condition: Nonoperational

(l) Wall Temperature: 0°F
Pressure: 1×10^{-7} mm Hg maximum
Cold Plate Condition: Minimum
Duration: 12 hours
Equipment Condition: Operational

(m) Wall and Air Temperature: Raise from 0°F to 75°F ± 20°F.
Pressure: Raise from 1×10^{-7} mm Hg to 5.00 ± 0.25 psia
Cold Plate Condition: From Minimum to Nominal
Duration: 2 hours

(n) Wall and Air Temperature: 75°F ± 20°F
Pressure: 5.00 ± 0.25 with the exception of two pressure blowdown cycles. Each blowdown cycle shall consist of a reduction in pressure to below 0.1 psia in 2.0 ± 1.0 minutes, maximum facility pumping for 20 minutes, and repressurization to 5.00 ± 0.25 psia in 1.0 ± 0.5 minutes
Cold Plate Condition: Nominal
Duration: 10 hours

Space condition external to LEM

(o) Cold Wall Temperature: -300°F ± 20°F.

Pressure: 1 x 10^{-7} mm Hg maximum

Solar Radiation: Two exposures to solar radiation at one solar constant for 8 hours each occurring once each during Steps (l) and (i). Standard MIL-STD-810, Method 517.1 shall be used as a guide.

4.2.6.2 Block II Thermal Vacuum

The G&N equipment peculiar to the CM, including the GNIC, PEA, PSA and G&N Harness shall be subjected to the Block II Thermal Vacuum Test conditions at the same time.

(a) Air Temperature: 75°F.

Pressure: 5.00 ± 0.25 psia

Cold Plate Condition: Nominal

Duration: 24 hours

(b) Wall Temperature: 75°F.

Pressure: 1 x 10^{-4} to 1 x 10^{-5} mm Hg

Cold Plate Condition: Nominal

Duration: 12 hours

(c)	Wall Temperature:	Raise from 75°F to 150°F
	Pressure:	1×10^{-4} to 1×10^{-5} mm Hg
	Cold Plate Condition:	Nominal to Maximum
	Duration:	4 hours
(d)	Wall Temperature:	150°F
	Pressure:	1×10^{-4} to 1×10^{-5} mm Hg
	Cold Plate Condition	Maximum
	Duration:	48 hours
(e)	Wall Temperature:	Reduce from 150°F to 0°F
	Pressure:	1×10^{-4} to 1×10^{-5} mm Hg
	Cold Plate Condition:	Maximum to Minimum
	Duration:	1 to 3 hours
(f)	Wall Temperature:	0°F
	Pressure:	1×10^{-4} to 1×10^{-5} mm Hg
	Cold Plate Condition:	Minimum
	Duration:	48 hours
(g)	Wall and Air Temperature:	Raise from 0°F to 75° ± 20°F
	Pressure:	Raise from (f) to Room Ambient
	Cold Plate Condition:	Minimum to Nominal
	Duration:	--

4.2.7 Cabin Atmosphere

The cabin atmosphere conditions are described herein. Unless otherwise indicated the time of exposure to an environment does not include the time required to attain that environment. The test sequence may be interrupted between lettered steps to facilitate scheduling problems, etc.; however, it is desired to complete the total cycle once it has been initiated. Unless otherwise specified, the temperature and pressure tolerances are ±5°F. and ±0.5 psi. The rate of temperature change shall not exceed 30°F per minute and the rate of pressure change shall not exceed 5 psia per minute. The temperature shall be chamber air ambient temperature.

The G&N equipment shall be subjected to the cabin atmosphere condition as indicated and detailed herein. During the exposure the equipment shall be operational and shall be exercised as completely as possible and checked within the limits imposed by chamber confinement. If the test sequence is interrupted, the equipment shall be functionally checked prior to reinitiating the test sequence. The equipment shall be mounted on airborne coldplates where normally provided, which shall be attached to a mounting fixture conductively isolated from the coldplate except at the mounting points. Non coldplate mounted G&N equipment shall have a fixture equipment interface temperature of 0°F minimum to 150°F maximum. The LEM AOT/CCRD and LEM SCA shall be subjected to steps a, b and c only. Equipment configuration shall be as specified in 4.2.4.1.

a. Air Temperature: 75°F.
Pressure: 21 psia
Oxygen: 95 ± 5%
Duration: 2 hours

b. Air Temperature: 75°F.
Pressure: 14.7 psia
Oxygen: 95 ± 5%
Duration: 12 hours.

c. Air Temperature: 105°F.
Pressure: 14.7 psia
Oxygen: 95 ± 5%
Duration: 12 hours.

d. Air Temperature: 75°F.
Pressure: 5 psia
Oxygen: 95 ± 5%
Duration: 24 hours

During this 24 hour exposure, a 1% by weight salt spray solution fog shall be intermittently imposed on the equipment 6 hours on and 6 hours off, for a total salt spray exposure of 12 hours. Standard MIL-STD-810 Method 509.1 may be used as a guide.

4.2.8 Electromagnetic Interference (EMI)

The EMI level and susceptibility of the G&N equipment shall be determined from MIL-I-26600/MSC-ASPO-EMI-10A. During this test, the equipment shall be operational in all equipment modes and exercised as completely as possible. Out-of-tolerance conditions shall be recorded and considered by NASA/MSC and MIT/IL. Modification shall be made only after an incompatibility with other systems or equipment is found. Equipment to be tested will be interconnected as a Block II G&N System and consist of the following:

IMU/NB (Block II)
PSA/SCA (Block II)
PEA
LGC (LEM)
DSKY (1)
CDU (LEM)
GNIC Panel
G&N Harness
OUA

APOLLO G&N Specification
ND 1002341 Rev. F
Original Issue Date: 5 OCT 67
Release Authority: TDRR 34808
Class A **Release**

PROCESS FOR
SPECIAL CONDITIONING OF RELAYS

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
	F		Initial Release		

This specification consists of page 1 to 14 inclusive.

APPROVALS	NASA/MSC	Eldon C Hall 9/15/67	W Stameris 15 Sept 67 MIT/IL	CCB 10/5/67	AC

1. SCOPE

1.1 PURPOSE. This specification establishes the minimum requirements for the acceptance of relays for use in deliverable end items. The procedures described herein shall be performed by the G&N Industrial Contractor as part of the incoming inspection, screen and burn-in.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents of the issue in effect on the date of this document form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-R-5757	Relays, Electrical (Excluding Thermal) for Electronic and Communication-Type Equipment, General Specification for
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

APOLLO G&N

ND1015404	Configuration Process and Quality Control Requirements for Suppliers of High Reliability Articles for Use in the Apollo G&N Systems

DRAWINGS

APOLLO G&N

1005001	Relay, Armature, Magnetic Latching
1005003	Relay, Armature, General Purpose
2004688	Relay, Armature Magnetic Latching (Flight Qualified)
2004689	Relay, Armature Magnetic Non-latching (Flight Qualified)

2.2 CONFLICTING REQUIREMENTS. In the event of conflict between the requirements, the following order of precedence shall apply. The Contractor shall notify MIT/IL APOLLO Management of the conflict.

a. The contract
b. This specification
c. Documents listed in this section

3. REQUIREMENTS

3.1 GENERAL. The provisions of this specification shall be applicable to all phases of acceptance of relays to the extent specified herein. Specific requirements or provisions not covered by this specification shall be as specified on the applicable drawings. In case of conflict of requirements between applicable drawings, this specification and other documents cited herein, the requirements of this specification shall govern.

3.2 IDENTIFICATION

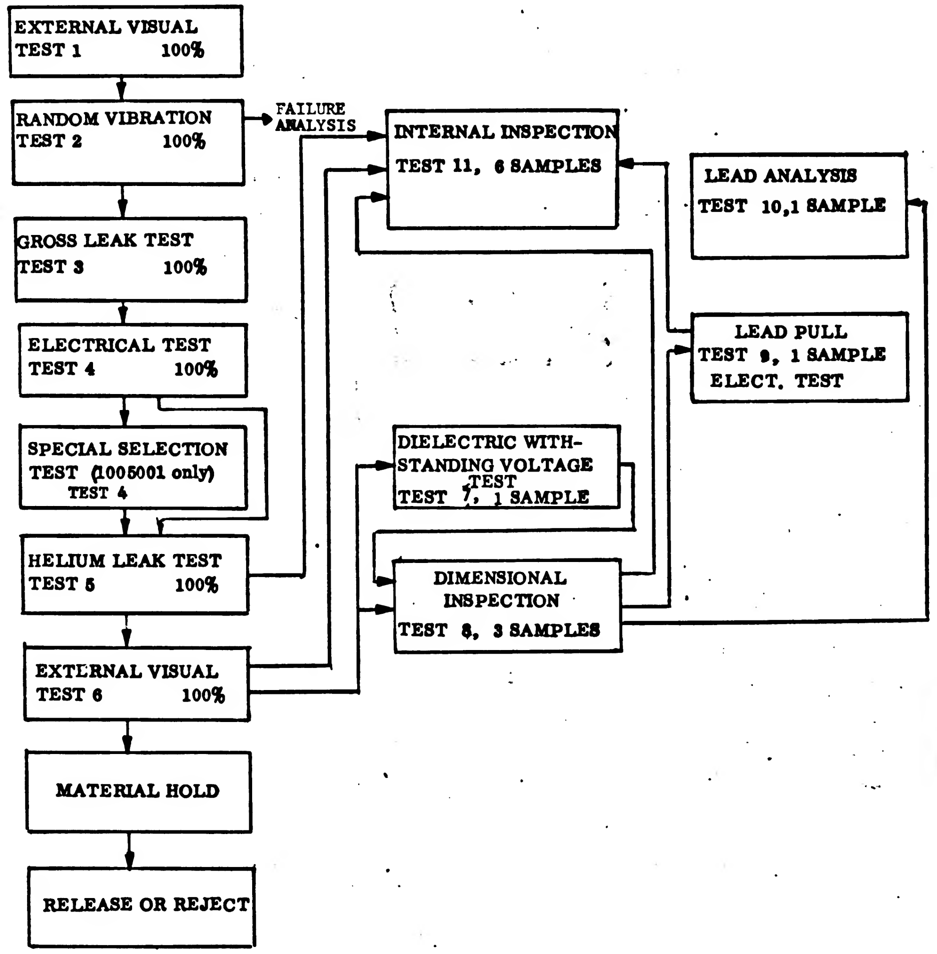
3.2.1 Lot Control. Each lot, as supplied by the vendor in compliance with the applicable drawing, shall be identified and maintained by the contractor throughout the test sequence. A lot is defined as all relays of the same part number received on a given date. A lot shall consist of 90 to 110 pieces.

3.2.2 Serialization. All units of a lot shall be serialized with individual identity maintained throughout the test sequence. All rejects shall be listed by serial number and actual magnitude of failure recorded.

3.3 TEST PROCEDURE. The test sequence shall be in accordance with the attached flow diagram (Figure 1).

3.3.1 Test Sequence. Test sequence shall be as follows:

a. External Visual Inspection (Test 1)
b. Random Vibration (Test 2)
c. Gross Leak (Test 3)
d. Electrical Test (Test 4)
e. Helium Leak (Test 5)
f. External Visual Inspection (Test 6)
g. Dielectrical Withstanding Voltage (Test 7) (Sample - see paragraph 3.3.4.6)
h. Dimensional Inspection (Test 8) 3 samples
i. Lead Pull Test (Test 9) See paragraph 3.3.4.8
j. Electrical Test (Test 4) Test 9 samples
k. Lead Material Analysis (Test 10) 1 sample
l. Internal Inspection (Test 11) Sample - See paragraph 3.3.4.10



FLOW DIAGRAM

FIGURE 1

Units passing random vibration shall be subjected to Test 3. All failed units from vibration test sequence 2 thru 6 shall be failure analysed. A maximum of five failed units from vibration test sequence 1, 7-9 inclusive shall be failure analysed.

3.3.4.3 Gross Leak Test (Test 3). Units shall be subjected to a gross leak test as described in MIL-R-5757, Section 4.7.2.1. Units passing this test shall be subjected to Test 4 and those failing shall be removed from the lot.and may be subjected to Test 10.

3.3.4.4 Electrical Test (Test 4).

3.3.4.4.1 SCD 1005001

3.3.4.4.1.1 The following test shall be performed at 25° ±3°C, with the limits as specified in the applicable drawings. Units passing this test shall be subjected to the Special Selection Test (3.3.4.4.1.2) and those failing shall be removed from the lot.and may be subjected to Test 10.

a. Must-operate voltage
b. Contact resistance
c. Coil resistance
d. Insulation resistance.

3.3.4.4.1.2 Special Selection Test. A pulse-operation test shall be performed. The pulse trains as specified in Figure 2 shall be applied to the coils as indicated. Units passing this test shall be subjected to Test 5. Units that fail this test but meet all other requirements of the SCD and the FPS shall be identified as "Special Selection" high voltage units and segregated from the units passing the test. prior to being subjected to test 5. The Special Selection high voltage units may be subjected to tests 7, 8, and 11.

3.3.4.4.2 SCD 1005003

3.3.4.4.2.1 The following tests shall be performed at 25° ±3°C, with the limits as specified on the applicable drawing. Units passing this test shall be subjected to Test 5 and those failing shall be removed from the lot.and may be subjected to Test 10.

a. Pull-in voltage
b. Drop-out voltage
c. Contact resistance
d. Coil resistance
e. Insulation resistance.

3.3.4.5 Helium Leak Test (Test 5). Units shall be subjected to a leak test as described in MIL-STD-202C, Method 112A.Condition C, Procedure IV.or Procedure IIIb. Allowable leak rate shall be not more than 1 x 10^{-8} cc/sec at one atmosphere pressure differential. Units passing this test shall be subjected to Test 6 and those failing may be subjected to Test 10 and 11. (Excess quantities of failed units shall be removed from the lot.)

3.3.4.6 Dielectric Withstanding Voltage Test (Test 7). One unit from each lot shall be subjected to the dielectric withstanding voltage test per the applicable SCD. If this unit passes the test, it shall be utilized in Test 8. If this sample fails, all units passing Test 6 shall be subjected to 80 per-cent of the voltage specified on the SCD. Units passing the 80 per-cent test shall be forwarded to Material Hold. Units failing the 80 per-cent test shall be removed from the lot.

3.3.4.7 Dimensional Inspection (Test 8). A sample of three pieces shall be subjected to dimensional check per the applicable SCD. Units passing this test shall be subjected to Tests 9, 10 and 11 (one each). If any unit fails, each unit passing Test 6 shall be inspected and those passing shall be moved to Materiel Hold and those failing shall be removed from the lot.

3.3.4.8 Lead Pull Test (Test 9). A sample from Test 8 shall be subjected to the lead pull requirement of the applicable SCD and then subjected to Test 4. If the unit passes, it shall be utilized in Test 11.

3.3.4.9 Lead Material Analysis (Test 10). A reject sample from Test 3,4,5 or a sample from Test 8 shall be subjected to lead material analysis and weld code verification. If unit passes, it shall be rejected and discontinued from further use.

3.3.4.10 Internal Visual Inspection (Test 11).

3.3.4.10.1 Six samples shall be subjected to Internal Visual Inspection.

Sample selection shall be from previously conducted tests in the following order of preference:

a. Test 8
b. Test 9
c. Test 5
d. Test 6 (Special Selection, high voltage)
e. Test 6

The samples shall be opened and inspected for workmanship and quality defects and violation of Para. 4.2.1. The samples shall be inspected under a 10X magnification for loose particles greater than one mil max. dimension (those not fused or bonded) both conductive and non-conductive, and any affixed foreign material.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. In order to assure proper control of the acceptance process covered by this specification, the contractor shall meet all the requirements specified herein and shall provide continuous audit of the acceptance process to assure compliance with the requirements of this specification.

4.1.1 Inspection. The contractor, through his quality assurance or control agency, shall be responsible for the performance of all inspection requirements and test specified herein.

4.1.2 Process Procedure/Quality Assurance Cross Reference Index.

Test No.	Title	Description Section 3	Quality Assurance Section 4
1.	External Visual Inspection	3.3.4.1	4.3
2.	Random Vibration	3.3.4.2	4.2.2
3.	Gross Leak Test	3.3.4.3	4.3
4.	Electrical Test	3.3.4.4	4.3
5.	Helium or Radiflo Leak Test	3.3.4.5	4.3
6.	External Visual Inspection	3.3.4.1	4.3
7.	Dielectric Withstanding Voltage Test	3.3.4.6	4.2.2
8.	Dimensional Inspection	3.3.4.7	4.3
9.	Lead Pull Test	3.3.4.8	4.2.2
10.	Lead Material Analysis	3.3.4.9	4.2.2
11.	Internal Visual Inspection	3.3.4.10	4.2.2

4.2 LOT REJECTION CRITERIA

4.2.1 Conformance to ND1015404. Disclosure of any violation of previously agreed to contractor-supplier ND1015404 Critical Process list without prior notification automatically fails the entire lot.

4.2.2 The lot shall be rejected if the number of rejects exceeds the criteria of Table I.

TABLE I

Random Vibration (Test 2)	The lot shall be rejected if both the total failures of Vibration Test Sequence 2 thru 6 exceeds 5% of the lot and the number of vibration failures in Vibration Test Sequence 6 exceeds the number of failures in Vibration Test Sequence 2 thru 5b.
Lead Pull (Test 9)	If one unit fails, two additional units which have passed Test 6 shall be subjected to this test. If either fails, the lot shall be rejected.
Lead Material Analysis (Test 10)	If the unit fails, two additional units which have passed test 6 shall be subjected to this test. If either unit fails, the entire lot shall be rejected.
Internal Visual Inspections (Test 11)	If five or more of the six samples exhibit loose particles greater than 20 mils maximum dimension, the entire lot shall be rejected.

4.3 TEST PROCESS CONTROL. All units shall be subjected to the provisions of Section 3 and processed in the sequence indicated in the flow diagram, Figure 1.

Material in process shall be identified and lot integrity maintained.

APOLLO G&N Specification
ND1002342 REV A
Original Issue Date: 23 FEB 67
Release Authority: TDRR 33061
Class A Release
Code Ident No. 80230

GFP RETEST SPECIFICATION
FOR
SIGNAL CONDITIONER
ASSEMBLY C/M OPERATIONAL
(DRAWING NO. 2007234)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
4/6/67	A	33536	2	MGM EA	-

This specification consists of page 1 to 5 inclusive.

APPROVALS	NASA/MSC	RMKowalski 14Feb67	MIT/IL	9 January 1967 AC	

2/1/67

APOLLO G&N Specification
ND1002342 REV -
Original Issue Date: 23 FEB 67
Release Authority: TDRR 33061
Class A Release
Code Ident No. 80230

GFP RETEST SPECIFICATION

FOR

SIGNAL CONDITIONER

ASSEMBLY C/M OPERATIONAL

(DRAWING NO. 2007234)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to 5 inclusive.

APPROVALS	NASA/MSC	RMKowalski 14Feb67	MIT/IL	9 January 1967 ACSP

2/1/67

APOLLO G&N Specification
ND 1002342 REV -
Original Issue Date: 23 FEB 67
Release Authority: TDRR 33061
Class A Release
Code Ident No. 80230

GFP RETEST SPECIFICATION

FOR

SIGNAL CONDITIONER

ASSEMBLY C/M OPERATIONAL

(DRAWING NO. 2007234)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to 5 inclusive.

APPROVALS	NASA/MSC	RMKowalski 14Feb67	MIT/IL	CC	9 January 1967 ACSP

1. SCOPE

1.1 PURPOSE. This specification establishes the test requirements for repaired GFP Signal Conditioner Assemblies C/M Operational, hereafter called the SCA, which have been returned for repair or replacement of nonconforming subassemblies.

1.2 DEVIATIONS. - Deviations from the requirements of this specification are permitted without waivers only as specified in the Apollo Repair Retest Order (ARRO) and as authorized by NASA/RASPO.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment
PS2007234	Procurement Specification, Product Configuration and Acceptance Test Requirements, Signal Conditioner Assembly C/M Operational

DRAWINGS

APOLLO G&N

[illegible]	[illegible]
2007270	Header Assembly Signal Conditioner C/M Operational

Add boiler plate

1. SCOPE

1.1 PURPOSE. This specification establishes the test requirements for repaired GFP Signal Conditioner Assemblies C/M Operational, hereafter called the SCA, which have been returned for repair or replacement of nonconforming subassemblies.

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PS2007234	Procurement Specification, Product Configuration and Acceptance Test Requirements, Signal Conditioner Assembly C/M Operational

DRAWINGS

APOLLO G&N

[illegible]	[illegible]
2007270	Header Assembly Signal Conditioner C/M Operational

All boiler plate

3. REQUIREMENTS

3.1 TEST CONDITIONS. Test Conditions for the SCA shall be as specified in PS2007234.

3.2 REPLACEMENT SUBASSEMBLIES. Only subassemblies that have met the requirements of their applicable procurement specifications shall be used as replacement subassemblies.

3.3 PRECAUTIONS. The situations which led to the repair or replacement of a nonconforming subassembly may also have induced a malfunction in other subassemblies. Before proceeding with retest of the SCA, detailed investigation is required regarding the proper operation of all subassemblies which interact with the nonconforming unit.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the SCA shall consist of Recertification Testing or Minimum Retests but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the SCA shall be subjected to testing as follows:

a. When the Header Assembly (Drawing 2007270) is replaced, all tests specified in Specification PS2007234 shall be performed.

b. When the Header Assembly is not replaced, all tests specified in Specification PS2007234, except the Workmanship-Vibration test, shall be performed.

4.3 MINIMUM RETEST. The SCA shall be subjected to the applicable test(s) listed in Table I only when Minimum Retest is specified by the ARRO. Figure 1 may be used as a reference to locate the specified modules.

TABLE I

TEST SELECTION

REPLACED COMPONENT	APPLICABLE TEST PARAGRAPH IN SPECIFICATION PS2007234
2007230 GIMBAL RESOLVER	. . . , 4.3.4, 4.3.5, 4.3.11 (Assembly sections A1 through A6 only)
2007231 PIPA AND IRIG	. . . , 4.3.4, 4.3.5, 4.3.11 (Assembly sections B1, B2, B3, B5, B6 and B7 only)
2007233 DAC, PIPA TEMP AND 2.5V BIAS	. . . , 4.3.4, 4.3.5, 4.3.11 (All assembly sections)
2007244 120 VOLT PIPA SUPPLY	. . . , 4.3.4, 4.3.5, 4.3.11 (Assembly section D1 only)
2007270 HEADER	Complete PS2007234

5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with paragraph 4.3.1 of PS2007234 and Specification ND1002214.

6. NOTES. None.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the SCA shall consist of Recertification Testing or Minimum Retests but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the SCA shall be subjected to testing as follows:

a. When the Header Assembly (Drawing 2007270) is replaced, all tests specified in Specification PS2007234 shall be performed.

b. When the Header Assembly is not replaced, all tests specified in Specification PS2007234, except the Workmanship-Vibration test, shall be performed.

4.3 MINIMUM RETEST. The SCA shall be subjected to the applicable test(s) listed in Table I only when Minimum Retest is specified by the ARRO. Figure 1 may be used as a reference to locate the specified modules.

TABLE I

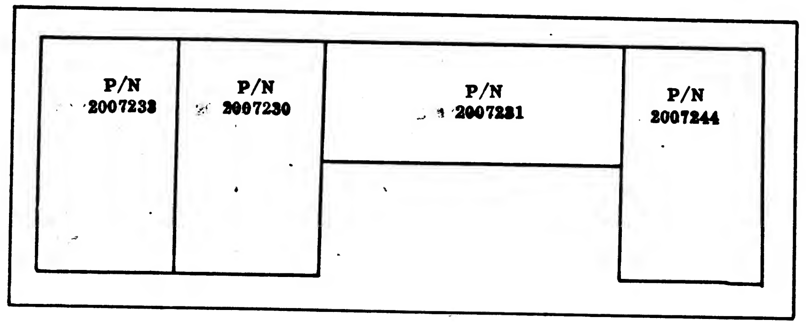
TEST SELECTION

REPLACED COMPONENT	APPLICABLE TEST PARAGRAPH IN SPECIFICATION PS2007234
2007230 GIMBAL RESOLVER	. . . , 4.3.4, 4.3.5, 4.3.11 (Assembly sections A1 through A6 only)
2007231 PIPA AND IRIG	. . . , 4.3.4, 4.3.5, 4.3.11 (Assembly sections B1, B2, B3, B5, B6 and B7 only)
2007233 DAC, PIPA TEMP AND 2.5V BIAS	. . . , 4.3.4, 4.3.5, 4.3.11 (All assembly sections)
2007244 120 VOLT PIPA SUPPLY	. . . , 4.3.4, 4.3.5, 4.3.11 (Assembly section D1 only)
2007270 HEADER	Complete PS2007234

5. PREPARATION FOR DELIVERY.

5.1 GENERAL. Preparation for delivery shall be in accordance with paragraph 4.3.1 of PS2007234 and Specification ND1002214.

6. NOTES. None.



MODULE LOCATION, C/M OPERATIONAL SCA

FIGURE 1

APOLLO G&N Specification
ND1002343 REV A
Original Issue Date: 23 FEB 67
Release Authority: TDRR 33062
Class A **Release**
CODE IDENT NO. 80230

GFP RETEST SPECIFICATION

FOR

SIGNAL CONDITIONER ASSEMBLY

LEM OPERATIONAL

DRAWING NO. 6007613

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
4/6/67	A	33536	2 [illegible]	MGM EA	–

This specification consists of page 1 to 5 inclusive.

APPROVALS	NASA/MSC	Kowalski 14Feb67	MIT/IL CCB	Piotrowski 9 January 1967 AC

2/1./67

APOLLO G&N Specification
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GFP RETEST SPECIFICATION
FOR
SIGNAL CONDITIONER ASSEMBLY
LEM OPERATIONAL
DRAWING NO. 6007013

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Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
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2/1./67

APOLLO G&N Specification
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CODE IDENT NO. 80230

GFP RETEST SPECIFICATION
FOR
SIGNAL CONDITIONER ASSEMBLY
LEM OPERATIONAL
DRAWING NO. 6007013

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to 5 inclusive.

APPROVALS	NASA/MSC	P.M. Kowalski 14Feb67	MIT/IL CCB	Piotrowski 9 January 1967 ACSP

1. SCOPE

1.1 PURPOSE. This specification establishes the test requirements for repaired LEM Operational Signal Conditioner Assemblies, hereafter called the SCA, which have been returned for repair or replacement of nonconforming subassemblies.

1.2 DEVIATIONS. Deviations from the requirements of this specification are permitted without waivers only as specified in the Apollo Repair Retest Order (ARRO) and as authorized by NASA/RASPO.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment
PS6007013	Procurement Specification, Product Configuration and Acceptance Test Requirements, Signal Conditioner Assembly, LEM Operational, Drawing No. 6007013

DRAWINGS

APOLLO G&N

6007014	Header Assembly, Signal Conditioner, LEM Operational

Add boiler plate

1. SCOPE

1.1 PURPOSE. This specification establishes the test requirements for repaired LEM Operational Signal Conditioner Assemblies, hereafter called the SCA, which have been returned for repair or replacement of nonconforming subassemblies.

1.2 DEVIATIONS. Deviations from the requirements of this specification are permitted without waivers only as specified in the Apollo Repair Retest Order (ARRO) and as authorized by NASA/RASPO.

2. APPLICABLE DOCUMENTS

2.1 EFFECTIVE ISSUES. The following documents form a part of this specification to the extent specified herein.

SPECIFICATIONS

APOLLO G&N

ND1002214	General Specification for Preservation, Packaging, Packing and Container Marking of APOLLO Guidance and Navigation Major Assemblies, Assemblies, Subassemblies, Parts and Associated Ground Support Equipment
PS6007013	Procurement Specification, Product Configuration and Acceptance Test Requirements, Signal Conditioner Assembly, LEM Operational, Drawing No. 6007013

DRAWINGS

APOLLO G&N

6007014	Header Assembly, Signal Conditioner, LEM Operational

Add boiler plate

3. REQUIREMENTS

3.1 TEST CONDITIONS. Test conditions for the SCA shall be as specified in Specification PS6007013.

3.2 REPLACEMENT SUBASSEMBLIES. Only subassemblies that have met the requirements of their applicable procurement specifications shall be used as replacement subassemblies.

3.3 PRECAUTIONS. The situations which led to the repair or replacement of a nonconforming subassembly may also have induced a malfunction in other subassemblies. Before proceeding with retest of the SCA, detailed investigation is required regarding the proper operation of all subassemblies which interact with the nonconforming unit.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the SCA shall consist of Recertification Testing or Minimum Retests but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the SCA shall be subjected to testing as follows:

a. When the Header Assembly (Drawing 6007014) is replaced, all tests specified in Specification PS6007013 shall be performed.

b. When the Header Assembly is not replaced, all tests specified in Specification PS6007013, except the Workmanship-Vibration test, shall be performed.

4.3 MINIMUM RETEST. The SCA shall be subjected to the applicable test(s) listed in Table I only when Minimum Retest is specified by the ARRO. Figure 1 may be used as a reference to locate the specified modules.

TABLE I

TEST SELECTION

REPLACED/REPAIRED COMPONENT	APPLICABLE TEST PARAGRAPH IN SPECIFICATION PS6007013
Gimbal Resolver (Dwg No. 2007230)	4.3.4, 4.3.5, 4.3.11 (Assembly sections A1 through A6 only)
PIPA and IRIG (Dwg No. 2007231)	4.3.4, 4.3.5, 4.3.11 (Assembly sections B1, B2, B3, B5, B6 and B7 only)
DAC, PIPA Temp and 2.5V Bias (Dwg No. 2007233)	4.3.4, 4.3.5, 4.3.11 (All assembly sections)
Radar Resolvers and 120V PIPA Supply (Dwg No. 6007012)	4.3.4, 4.3.5, 4.3.11 (Assembly sections D1 through D5 only)
Header Assembly (Dwg No. 6007014)	Complete PS6007013

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with paragraph 4.3.1 of Specification PS6007013 and Specification ND1002214.

6. NOTES. None.

JD:jls

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the SCA shall consist of Recertification Testing or Minimum Retests but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the SCA shall be subjected to testing as follows:

a. When the Header Assembly (Drawing 6007014) is replaced, all tests specified in Specification PS6007013 shall be performed.

b. When the Header Assembly is not replaced, all tests specified in Specification PS6007013, except the Workmanship-Vibration test, shall be performed.

4.3 MINIMUM RETEST. The SCA shall be subjected to the applicable test(s) listed in Table I only when Minimum Retest is specified by the ARRO. Figure 1 may be used as a reference to locate the specified modules.

TABLE I

TEST SELECTION

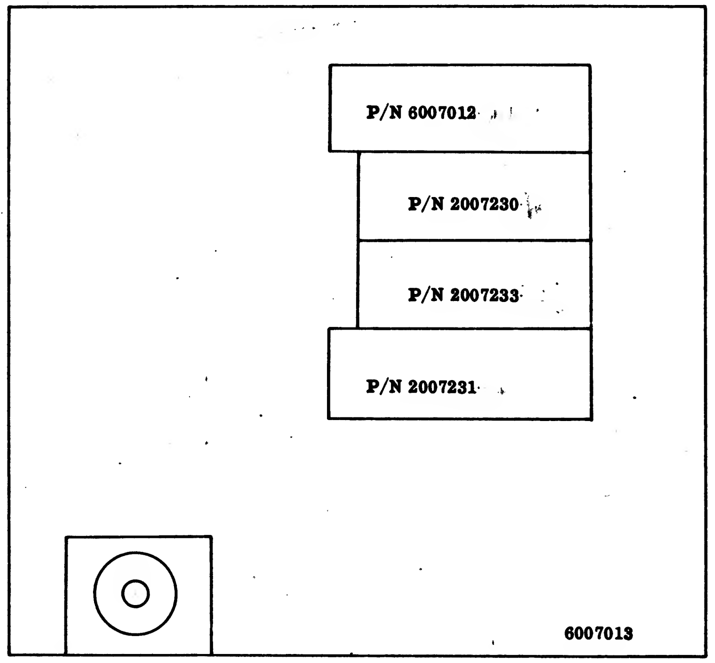
REPLACED/REPAIRED COMPONENT	APPLICABLE TEST PARAGRAPH IN SPECIFICATION PS6007013
Gimbal Resolver (Dwg No. 2007230)	4.3.4, 4.3.5, 4.3.11 (Assembly sections A1 through A6 only)
PIPA and IRIG (Dwg No. 2007231)	4.3.4, 4.3.5, 4.3.11 (Assembly sections B1, B2, B3, B5, B6 and B7 only)
DAC, PIPA Temp and 2.5V Bias (Dwg No. 2007233)	4.3.4, 4.3.5, 4.3.11, [illegible] (All assembly sections) [illegible])
Radar Resolvers and 120V PIPA Supply (Dwg No. 6007012)	4.3.4, 4.3.5, 4.3.11 (Assembly sections D1 through D5 only)
Header Assembly (Dwg No. 6007014)	Complete PS6007013

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall be in accordance with paragraph 4.3.1 of Specification PS6007013 and Specification ND1002214.

6. NOTES. None.

JD:jls



MODULE LOCATION, LEM OPERATIONAL SCA

FIGURE 1

APOLLO G&N Specification
ND 1002345 REV A
Original Issue Date: 15 Dec 66
Release Authority: TDRR 32354
Class A **Release**

DESCRIPTION AND REQUIREMENTS
FOR
COMPLETING ACC FORM 1 (REVISED)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
9/29/67	A	34780	2, 3 [illegible]	EA	---

This specification consists of page 1 to 5 inclusive.

APPROVALS	NASA/MSC	N/A MIT/IL	12/10/66 AC Electronics

I. Purpose

A. This specification defines the use of and provides instructions for completing Apollo configuration control (ACC) Form No. 1 (Revised).

II. Application

A. ACC Form No. 1 (Revised) shall be completed at the time of replacement or repair of all Apollo Airborne GFP components and the modification of all Airborne and GSE Apollo GFP components.

B. All RIB's shall contain as the last page a partially completed ACC Form No. 1 (Revised) as defined herein.

III. Procedure for Completing ACC Form No. 1 (Revised) During Repair/Modification of Apollo GFP

A. Reporting requirements for ACC Form No. 1 (Revised) consists of two parts:

1. Part I will be completed whenever Apollo Airborne or GSE GFP equipment is repaired or modified.

2. Part II will be completed whenever Apollo Airborne GFP equipment is replaced, repaired or modified.

B. Detailed Instructions

NOTE: The partially filled-in ACC Form 1 (revised) included in each RIB shall be completed for each retrofit accomplished on Apollo GFP equipment. Blank forms shall be used to report repair of Apollo Airborne GFP equipment.

1. Insert document control number (reporting facility identifier plus sequential number; e.g., GAEC-1, GAEC-2, etc.), name of reporting facility, date retrofit or repair is initiated, and the G&N number which is being retrofitted or repaired. If the assembly is a spare, enter the word "SPARE" instead of a G&N number.

2. Complete Part 1 as follows:

   a. Indent - Insert a numeric designator (1, 2, 3) for each entry.

   b. Equipment Name - Insert name of each serialized assembly involved in the retrofit or repair, starting with the highest assembly down to the lowest affected subassembly.

   c. Equipment P/N Prior to Repair/Retro. - Insert/complete the part number for each different assembly listed in the Equipment Name column prior to its repair or retrofit.

   d. Equipment S/N - Insert serial number for each assembly listed.

   e. Retrofit Installed - Insert the retrofit ECP Number and kit part and serial numbers. Insert N/A for repairs.

f. Equipment P/N or MD Sym. After Retro. - Insert/complete the new part number, or modification symbol assigned to the retrofitted assembly. Insert N/A for repairs and if there is no part number change or modification symbol assignment after retrofit.

g. Additional Information - Add any additional pertinent information including changes in equipment serial numbers after modification, i.e., "S/N_____."

3. MODS Installed (Bottom of Form) - The individual responsible for the retrofit or repair shall enter the date the change was completed and sign the form.

4. Q.A. Verification (Bottom of Form) - Quality Assurance individual responsible for inspecting the replacement, retrofit or repair shall enter the date of verification and sign the form.

5. Complete Part II as follows:

   a. Indent - Insert the Part I "Indent" number of the assembly affected.

   b. Parts A/R - Insert "A" or "R" indicating that the part is added/removed.

   c. Qty. - Insert the quantity of the added/removed part.

   d. Part Name - Insert name of the added/removed part.

   e. P/N - Insert/complete part number of the added/removed part.

   f. S/N - Insert serial number of the added/removed part. If it has no serial number, leave blank.

   g. Lot No. - Insert lot number of the added/removed part. If it has no lot number, leave blank.

   h. REF/Circuit Designator - Insert the reference or circuit designator where applicable.

   i. Additional Information - Add any additional pertinent information.

6. Copies of ACC Form No. 1 (Revised) should be made and retained by the reporting facility. The original shall be forwarded to the following address as soon as possible after its completion.

AC Electronics Division
General Motors Corporation
Milwaukee, Wisconsin 53201

Attention: Apollo Logistics Support
Dept. 38-05, Bldg. 2B

IV. Procedure for Preparing RIB copy of ACC Form No. 1 (Revised)

A. General. All RIB's shall contain a partially completed ACC Form No. 1 (Revised). The form will be completed to the maximum extent possible at the time the RIB is

APOLLO G&N Specification
ND 1002345 REV B
Original Issue Date: 15 DEC 66
Release Authority: TDRR 32354
Class A Release

DESCRIPTION AND REQUIREMENTS
FOR
COMPLETING ACC FORM 1 (REVISED)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
9/29/67	A	34780	2, 3	EA	---
10/5/67	B	34796	3	EA	---

This specification consists of page 1 to 5 inclusive.

APPROVALS	NASA/MSC	N/A MIT/IL	12/10/66 AC Electronics

APOLLO G&N Specification
ND 1002345
Original Issue Date: 15 DEC 66
Release Authority: TDRR 32354
Class A Release

DESCRIPTION AND REQUIREMENTS
FOR
COMPLETING ACC FORM 1 (REVISED)

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to 5 inclusive.

APPROVALS	NASA/MSC	N/A MIT/IL	12/10/66 AC Electronics

I. Purpose

A. This specification defines the use of and provides instructions for completing Apollo configuration control (ACC) Form No. 1 (Revised).

II. Application

A. ACC Form No. 1 (Revised) shall be completed during the repair of all Apollo Airborne GFP components and the modification of all Airborne and GSE Apollo GFP components.

B. All RIB's shall contain as the last page a partially completed ACC Form No. 1 (Revised) as defined herein.

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A. Reporting requirements for ACC Form No. 1 (Revised) consists of two parts:

1. Part I will be completed whenever Apollo Airborne or GSE GFP equipment is repaired or modified.

2. Part II will be completed whenever Apollo Airborne GFP equipment is repaired or modified.

B. Detailed Instructions

NOTE: The partially filled-in ACC Form 1 (revised) included in each RIB shall be completed for each retrofit accomplished on Apollo GFP equipment. Blank forms shall be used to report repair of Apollo Airborne GFP equipment.

1. Insert document control number (reporting facility identifier plus sequential number; e.g., GAEC-1, GAEC-2, etc.), name of reporting facility, date retrofit or repair is initiated, and the G&N number which is being retrofitted or repaired. If the assembly is a spare, enter the word "SPARE" instead of a G&N number.

2. Complete Part 1 as follows:

   a. Indent - Insert a numeric designator (1, 2, 3) for each entry.

   b. Equipment Name - Insert name of each serialized assembly involved in the retrofit or repair, starting with the highest assembly down to the lowest affected subassembly.

   c. Equipment P/N Prior to Repair/Retro. - Insert/complete the part number for each different assembly listed in the Equipment Name column prior to its repair or retrofit.

   d. Equipment S/N - Insert serial number for each assembly listed.

   e. Retrofit Installed - Insert the retrofit ECP Number and kit part and serial numbers, Insert N/A for repairs.

f. Equipment P/N or MD Sym. After Retro. - Insert/complete the new part number, or modification symbol assigned to the retrofitted assembly. Insert N/A for repairs and if there is no part number change or modification symbol assignment after retrofit.

g. Additional Information - Add any additional pertinent information including changes in equipment serial numbers after modification, i.e., "S/N_____."

3. MODS Installed (Bottom of Form) - The individual responsible for the retrofit or repair shall enter the date the change was completed and sign the form.

4. Q.A. Verification (Bottom of Form) - The Quality Assurance individual responsible for inspecting the retrofit or repair shall enter the date of verification and sign the form.

5. Complete Part II as follows:

   a. Indent - Insert the Part I "Indent" number of the assembly affected.

   b. Parts A/R - Insert "A" or "R" indicating that the part is added/removed.

   c. Qty. - Insert the quantity of the added/removed part.

   d. Part Name - Insert name of the added/removed part.

   e. P/N - Insert/complete part number of the added/removed part.

   f. S/N - Insert serial number of the added/removed part. If it has no serial number, leave blank.

   g. Lot No. - Insert lot number of the added/removed part. If it has no lot number, leave blank.

   h. REF/Circuit Designator - Insert the reference or circuit designator where applicable.

   i. Additional Information - Add any additional pertinent information.

6. Copies of ACC Form No. 1 (Revised) should be made and retained by the reporting facility. The original shall be forwarded to the following address as soon as possible after its completion.

AC Electronics Division
General Motors Corporation
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Attention: Apollo Logistics Support
Dept. 38-05, Bldg. 2B

IV. Procedure for Preparing RIB copy of ACC Form No. 1 (Revised)

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APOLLO G&N Specification
ND1002346 REV- A
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GFP RETEST SPECIFICATION

FOR

LEM INERTIAL SUBSYSTEM

Record of Revisions

(A)

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
10/22/67	A	34912	4-7, 10	MGM EA	--

This specification consists of page 1 to 12 inclusive.

APPROVALS	NASA/MSC	W Stameks 6 Apr 67 MIT/IL	3/24/67	T.A. Stover AC

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the ISS shall consist of Recertification Testing or Minimum Retests but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the replaced assemblies shall be subjected to testing as follows:

4.2.1 Power and Servo Assembly Tests. After replacement of the PSA (Drawings 6007009 or 6007200) recertification of the ISS shall be as follows:

a. Installation JDC's as required (see 4.3.1),

b. Previbration JDC's 16032, 16033, 16039, 16067, 16075, 16079, 16106 and 16160 (See 6.3).

4.2.2 Inertial Measurement Unit and Pulse Torque Assembly Tests (IMU or IMU/PTA Repair). Recertification of the IMU/PTA (Drawing No. 6007001) shall be as follows when only the IMU has been repaired or when both the IMU and PTA have been repaired.

a. Previbration JDC's in the Test Flowgram (LEM) of ATP6015497 and vibration in accordance with Specification ND1002275 with the following exceptions:

   (1) Vibration need be performed only along the axis specified in Table II for the part replaced. If no axis is specified, then no vibration or Previbration testing is required.

   (2) Vibration and Previbration testing is required for PIPA and IRIG replacement only if the replacement PIPA or IRIG has not previously been subjected to an equivalent vibration.

   (3) JDC's 16159, 16155, 16156, and 16157 (as applicable) shall be performed only for PIPA or PIPA Electronics replacements.

b. Postvibration JDC's in the test Flowgram (LEM) of ATP6015497 with the following exceptions:

   (1) Exclude JDC's 16079, 16080, 16097, 16098, 16110, and 16246.

   (2) Exclude JDC 16245 when the IMU has not been vibrated. If IMU was vibrated, perform only the temperature control portions.

   (3) Exclude JDC 16017 when the IG, MG, and OG 16X and 1X resolvers (Drawing Number 2018631) and the gyro error resolver (Drawing Number 2018632) have not been replaced.

   (4) Exclude JDC's 16082, 16083, and 16084 when the IG, MG, OG 16X and 1X resolvers (Drawing Number 2018631) have not been replaced. When replacements are made, perform only the JDC applicable to the resolver replaced.

TABLE II (Continued)

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	AXIS OF VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
2021500	IRIG Prealigned Assembly (X)	X*4	16236, 16237, 16238, 16179*1
2021500	IRIG Prealigned Assembly (Y)	Y*4	16239, 16240, 16241, 16179*1
2021500	IRIG Prealigned Assembly (Z)	Z*4	16242, 16243, 16244, 16179*1
Wires	Soldered wire joints (10 or less)		*3

*1 Perform only that portion applicable to the unit replaced.
*2 Replace appropriate calibration module.
*3 No JDC's required. Visual inspection necessary for each wire joint. Where 11 or more soldered wire joints are repaired, vibrate as specified by ARBO.
*4 If the PIP or IRIG was replaced after vibration and if the replacement PIP or IRIG was vibrated, the IMU need not be vibrated again.
*5 Exclude all JDC's specified in 4.3.5.2 except JDC 18030.

APOLLO G&N Specification
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GFP RETEST SPECIFICATION

FOR

LEM INERTIAL SUBSYSTEM

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10/22/67	A	34912	4-7, 10	MGM EA	--
3/28/68	B	35985	5, 9, 10	MGM EA	--

This specification consists of page 1 to 12 inclusive.

APPROVALS	NASA/MSC	6 Apr 67 MIT/IL	3/29/67 T.A. Stone AC

TABLE II

INERTIAL MEASUREMENT UNIT (DRAWING NO. 2018601) TEST METHOD

ASSEMBLY DWG NO.	PART NAME OF REPAIRED OR REPLACED ITEM	1X3 VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
1001485	Thermostat	Yes	
2007019	Ducosyn Transformer		
2007060	PIP Pre-Amp Assembly (X)		16200, 16201
2007060	PIP Pre-Amp Assembly (Y)		16202, 16203
2007060	PIP Pre-Amp Assembly (Z)		16204, 16205
2007064	Temperature Control Module		
2007170	Temperature Alarm Module		
2007171	Blower Control Module		
2007172	Blower Control Module		
2007204	Precision Resolver Alignment Assy		16194
2018623	Frameless DC Torque Motor (IG)	Yes	
2018623	Frameless DC Torque Motor (MG)	Yes	
2018624	40 Contact Slip Ring Assembly (MGA)	Yes	16106 [illegible]
2018625	Slip Ring Assembly (OGA)	Yes	16106 [illegible]
2018629	Frameless DC Torque Motor (OG)	Yes	
2018631	16X and 1X Resolvers (IG)	Yes	16194, 16082
2018631	16X and 1X Resolvers (MG)	Yes	16194, 16083
2018631	16X and 1X Resolvers (OG)	Yes	16194, 16084
2018632	Gyro Error Resolver	Yes	16108
2018634	40 Contact Slip Ring Assembly (IGA)	Yes	16106 [illegible]
2018635	Thermostat & Heater	Yes	
2018636	Thermostat Temp Alarm	Yes	
2018637	Thermostat & Heater Temp Control	Yes	
2018639	PIP and Capacitor Module (X)*2	Yes*4	16159, 16155, 16200, 16201
2018639	PIP and Capacitor Module (Y)*2	Yes*4	16159, 16156, 16202, 16203
2018639	PIP and Capacitor Module (Z)*2	Yes*4	16159, 16157, 16204, 16205
2018641	Stable Member Heater		
2018644	Variable Speed Blower	Yes	(See below)*5
2018741	Heater & Tapered Mount		
2018823	Thermostat & Heater Temp Alarm Hi	Yes	
2018824	Thermostat Temp Alarm Lo	Yes	
2018825	Thermostat & Heater	Yes	
2018826	Thermostat & Heater Temp Control	Yes	

TABLE II (Continued)

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	A 1X3 VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
2021500	IRIG Prealigned Assembly (X)	Yes *4	16236, 16237, 16238, 16179*1
2021500	IRIG Prealigned Assembly (Y)	Yes *4	16239, 16240, 16241, 16179*1
2021500	IRIG Prealigned Assembly (Z)	Yes *4	16242, 16243, 16244, 16179*1
Wires	Soldered wire joints (10 or less)		*3

*1 Perform only that portion applicable to the unit replaced.
*2 Replace appropriate calibration module.
*3 No JDC's required. Visual inspection necessary for each wire joint. Where 11 or more soldered wire joints are repaired, vibrate as specified by ARBO.
*4 If the PIP or IRIG was replaced after vibration and if the replacement PIP or IRIG was vibrated, the IMU need not be vibrated again.
*5 Exclude all JDC's specified in 4.3.5.2 except JDC 18030.

APOLLO G&N Specification
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GFP RETEST SPECIFICATION

FOR

LEM INERTIAL SUBSYSTEM

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Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				AC	NASA
10/22/67	A	34912	4-7, 10	MGM EA	--
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12/15/69	C	37974	9	MGM EA	MDH

This specification consists of page 1 to 12 inclusive.

APPROVALS NASA/MSC W Stameris 6 Apr 67 MIT/IL CCB R.A. McKern 3/29/67 N.G. Cook T.A. Stover AC JF Dunnenberger

TABLE II

INERTIAL MEASUREMENT UNIT (DRAWING NO. 2018601) TEST METHOD

ASSEMBLY DWG NO.	PART NAME OF REPAIRED OR REPLACED ITEM	[illegible] VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
1001485	Thermostat	Yes	
2007019	Ducosyn Transformer		
2007060	PIP Pre-Amp Assembly (X)		16200, 16201
2007060	PIP Pre-Amp Assembly (Y)		16202, 16203
2007060	PIP Pre-Amp Assembly (Z)		16204, 16205
2007064	Temperature Control Module		
2007170	Temperature Alarm Module		
2007171	Blower Control Module		
2007172	Blower Control Module		
2007204	Precision Resolver Alignment Assy		16194
2018623	Frameless DC Torque Motor (IG)	Yes	
2018623	Frameless DC Torque Motor (MG)	Yes	
2018624	40 Contact Slip Ring Assembly (MGA)	Yes	16106 (See below)^{*5}
2018625	Slip Ring Assembly (OGA)	Yes	16106 (See below)^{*5}
2018629	Frameless DC Torque Motor (OG)	Yes	
2018631	16X and 1X Resolvers (IG)	Yes	16194, 16082
2018631	16X and 1X Resolvers (MG)	Yes	16194, 16083
2018631	16X and 1X Resolvers (OG)	Yes	16194, 16084
2018632	Gyro Error Resolver	Yes	16108
2018634	40 Contact Slip Ring Assembly (IGA)	Yes	16106 (See below)^{*5}
2018635	Thermostat & Heater	Yes	
2018636	Thermostat Temp Alarm	Yes	
2018637	Thermostat & Heater Temp Control	Yes	
2018639	PIP and Capacitor Module (X)^{*2}	Yes^{*4}	16159, 16155, 16200, 16201
2018639	PIP and Capacitor Module (Y)^{*2}	Yes^{*4}	16159, 16156, 16202, 16203
2018639	PIP and Capacitor Module (Z)^{*2}	Yes^{*4}	16159, 16157, 16204, 16205
2018641	Stable Member Heater		
2018644	Variable Speed Blower	[illegible]	(See below)^{*5}
2018741	Heater & Tapered Mount		
2018823	Thermostat & Heater Temp Alarm Hi	Yes	
2018824	Thermostat Temp Alarm Lo	Yes	
2018825	Thermostat & Heater	Yes	
2018826	Thermostat & Heater Temp Control	Yes	

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GFP RETEST SPECIFICATION

FOR

LEM INERTIAL SUBSYSTEM

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3. REQUIREMENTS

3.1 TEST CONDITIONS. Test conditions for the ISS shall be as specified in ATP6015497.

3.1.1 TEST EQUIPMENT. In addition to GSE test equipment, supplementary test equipment shall consist of Coupling Display Unit (CDU), Inertial Measurement Unit/Pulse Torque Assembly (IMU/PTA) and Power and Servo Assembly (PSA) assemblies, as required, that have met the functional requirements of their procurement or repair documents.

3.2 REPLACEMENT ASSEMBLIES. Only those CDU, IMU/PTA, or PSA assemblies which have met the requirements of their applicable procurement or repair documents shall be used as replacement assemblies.

3.3 REPLACEMENT SUBASSEMBLIES. Only subassemblies that have met the requirements of their applicable procurement documents shall be used as replacement subassemblies.

3.4 JDC TEST SEQUENCE. The sequence of performing JDC's shall be as indicated in the Test Flowgram (LEM) of ATP6015497.

3.5 PRECAUTIONS. The situations which led to the repair or replacement of a nonconforming subassembly may also have induced a malfunction in other subassemblies. Before proceeding with retest of the ISS, detailed investigation is required regarding the proper operation of all subasseblies which interact with the nonconforming unit.

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the ISS shall consist of Recertification Testing or Minimum Retests but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the replaced assemblies shall be subjected to testing as follows:

4.2.1 Power and Servo Assembly Tests. After replacement of the PSA (Drawings 6007009 or 6007200) recertification of the ISS shall be as follows:

a. Installation JDC's as required (see 4.3.1),

b. Previbration JDC's 16032, 16033, 16039, 16067, 16075, 16079, 16106 and 16160 (See 6.3).

4.2.2 Inertial Measurement Unit and Pulse Torque Assembly Tests (IMU or IMU/PTA Repair). Recertification of the IMU/PTA (Drawing No. 6007001) shall be as follows when only the IMU has been repaired or when both the IMU and PTA have been repaired.

a. Previbration JDC's in the Test Flowgram (LEM) of ATP6015497,

b. Vibration in accordance with Specification ND1002275, except when either PIPA's or IRIG's that have been vibrated are installed or when parts listed in Table II that do not have an axis of vibration specified are replaced.

c. All post-vibration JDC's in the Test Flowgram (LEM) of ATP6015497 (excluding JDC's 16017, 16080, 16082, 16083, 16084, 16097, 16098, 16108, and 16246 and all of JDC 16245 except the temperature control portion) with the following exceptions: When the IG, MG or OG 16X and 1X resolvers (Drawing Number 2018631) are replaced, include JDC 16017, 16082, 16083 or 16084 as applicable; when the gyro error resolver (Drawing Number 2018632) is replaced, include JDC16017 and JDC16108.

4.2.3 Inertial Measurement Unit and Pulse Torque Assembly Tests (PTA Repair). Recertification of the IMU/PTA (Drawing 6007001) shall be as follows when only the PTA has been repaired.

a. When the PTA header assembly and modules are replaced, the PTA shall be subject to the following tests.

(1) Installation JDC's as required (see 4.3.1),

(2) Previbration JDC's 16032, 16033, 16039, 16067 and 16106 and adjustment JDC's 16155, 16156 and 16157 as required.

   (3) Vibration in accordance with Specification ND1002275, except that the IMU may be mounted adjacent to the vibration test fixture,

   (4) Post-vibration JDC's: JDC 16245 (temperature control portion only) plus installation JDC's as required and then JDC's 16032, 16033, 16039, 16067, 16200, 16201, 16202, 16203, 16204, 16205, 16238, 16241, and 16244.

b. When the PTA header assembly is not replaced, the PTA shall be subjected to the following tests.

   (1) Installation JDC's as required (see 4.3.1),

   (2) JDC's 16032, 16033, 16039, 16067, 16106, 16200, 16201, 16202, 16203, 16204, 16205, 16238, 16241 and 16244, and adjustment JDC's 16155, 16156 and 16157 as required.

4.2.4 Inertial Measurement Assembly and Pulse Torque Assembly Tests (IMU/PTA Replacement). Recertification of the ISS after replacement of the IMU/PTA shall be as follows:

a. Installation JDC's as required (see 4.3.1),

b. Post-vibration JDC's 16039, 16075, 16108, 16067, 16110, 16200, 16201, 16202, 16203, 16204, 16205, 16238, 16241, 16244, 16194, 16236, 16237, 16239, 16240, 16242 and 16243.

4.2.5 Coupling Data Unit Tests. Recertification of the ISS after replacement of the CDU (Drawing 2007222) shall be accomplished as follows:

a. Installation JDC's as required (see 4.3.1),

b. Postvibration JDC's 16032, 16033, 16039, 16080, 16082, 16083, 16084, 16097, 16098 and 16108 (Vibration shall not be required).

4.3 MINIMUM RETEST. The ISS shall be subjected to the applicable test in this paragraph only when Minimum Retest is specified by NASA/RASPO.

4.3.1 Installation JDC's. The following JDC's shall be performed as required.

a. JDC 16009, IMU and PTA/PEA Mounting Fixture Installation on Rotary Table
b. JDC 16013, IMU Installation on IMU Mounting Fixture
c. JDC 16014, PTA Installation on PTA Holding Fixture
d. JDC 16017, CDU Installation
e. JDC 16018, PSA Installation
f. JDC 16019, Cable and Coolant Hose Connections.

4.3.2 Initial Operating JDC's. The following JDC's shall be performed after all ISS components have been installed on the test pad, prior to the JDC's specified for replaced components as listed in Tables I, II, III and IV. They shall also be performed if no JDC's are specified.

a. JDC 16032, Turn On of OIA Power
b. JDC 16033, First Time Turn On of ISS Power
c. JDC 16039, Power Supply Tests.

4.3.3 Auxiliary Operating JDC's, The following JDC's shall be performed as required.

a. JDC 16030, Inertial Subsystem Turn Off
b. JDC 16034, Normal ISS and OIA Power Turn On.

4.3.4 Degaussing JDC's. The following JDC's shall be performed when specified by NASA/RASPO.

a. JDC 16153, IRIG Degaussing
b. JDC 16159, PIPA Degaussing.

4.3.5 ISS Assembly Tests. In addition to performing the applicable JDC's specified in 4.3.1, 4.3.2, 4.3.3 and 4.3.4, selected testing for the LEM ISS assemblies shall be performed as follows:

4.3.5.1 Power and Servo Assembly (PSA). Selected testing for the PSA shall be as specified in Table I.

4.3.5.2 Inertial Measurement Unit (IMU). Selected testing for the IMU shall be as specified in Table II. In addition to the JDC's specified in Table II, the following JDC's shall be performed after replacing any of the components listed in Table II. If the IMU is vibrated, the temperature control portion of JDC 16245 shall be performed following vibration.

a. JDC 16010
b. JDC 16011
c. JDC 16012
d. JDC 16067
e. JDC 16075
f. JDC 16161
g. JDC 16162
h. JDC 16163
i. JDC 16164
j. JDC 16165
k. JDC 16166
m. JDC 16167
n. JDC 16168
p. JDC 16169
q. JDC 16170
r. JDC 16178
s. JDC 18030

4.3.5.3 Pulse Torque Assembly (PTA). Selected testing for the PTA shall be as specified in Table III.

4.3.5.4 Coupling Display Unit (CDU). Selected testing for the CDU shall be as specified in Table IV.

TABLE II

INERTIAL MEASUREMENT UNIT (DRAWING NO. 2018601) TEST METHOD

ASSEMBLY DWG NO.	PART NAME OF REPAIRED OR REPLACED ITEM	AXIS OF VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
1001485	Thermostat	Z	
2007019	Ducosyn Transformer		
2007060	PIP Pre-Amp Assembly (X)		16200, 16201
2007060	PIP Pre-Amp Assembly (Y)		16202, 16203
2007060	PIP Pre-Amp Assembly (Z)		16204, 16205
2007064	Temperature Control Module		
2007170	Temperature Alarm Module		
2007171	Blower Control Module		
2007172	Blower Control Module		
2007204	Precision Resolver-Alignment Assy		16194
2018623	Frameless DC Torque Motor (IG)	Y	
2018623	Frameless DC Torque Motor (MG)	Z	
2018624	40 Contact Slip Ring Assembly (MGA)	Z	16106 (See below)*5
2018625	Slip Ring Assembly (OGA)	X	16106 (See below)*5
2018629	Frameless DC Torque Motor (OG)	X	
2018631	16X and 1X Resolvers (IG)	Y	16194, 16082
2018631	16X and 1X Resolvers (MG)	Z	16194, 16083
2018631	16X and 1X Resolvers (OG)	X	16194, 16084
2018632	Gyro Error Resolver	Y	16108
2018634	40 Contact Slip Ring Assembly (IGA)	Y	16106 (See below)*5
2018635	Thermostat & Heater	Z	
2018636	Thermostat Temp Alarm	Z	
2018637	Thermostat & Heater Temp Control	Z	
2018639	PIP and Capacitor Module (X)*2	X*4	16159, 16155, 16200, 16201
2018639	PIP and Capacitor Module (Y)*2	Y*4	16159, 16156, 16202, 16203
2018639	PIP and Capacitor Module (Z)*2	Z*4	16159, 16157, 16204, 16205
2018641	Stable Member Heater		
2018644	Variable Speed Blower		(See below)*5
2018741	Heater & Tapered Mount		
2018823	Thermostat & Heater Temp Alarm Hi	Z	
2018824	Thermostat Temp Alarm Lo	Z	
2018825	Thermostat & Heater	Z	
2018826	Thermostat & Heater Temp Control	Z	

TABLE II (Continued)

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	AXIS OF VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
2021500	IRIG Prealigned Assembly (X)	X*4	16236, 16237, 16238, 16179*1
2021500	IRIG Prealigned Assembly (Y)	Y*4	16239, 16240, 16241, 16179*1
2021500	IRIG Prealigned Assembly (Z)	Z*4	16242, 16243, 16244, 16179*1
Wires	Soldered wire joints (10 or less)		*3

*1 Perform only that portion applicable to the unit replaced.
*2 Replace appropriate calibration module.
*3 No JDC's required. Visual inspection necessary for each wire joint.
*4 If the PIP or IRIG was replaced after vibration and if the replacement PIP or IRIG was vibrated, the IMU need not be vibrated again.
*5 Exclude all JDC's specified in 4.3.5.2 except JDC 18030, [illegible]

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4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the ISS shall consist of Recertification Testing or Minimum Retests, but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the replaced assemblies shall be subjected to testing as follows:

4.2.1 Power and Servo Assembly Tests. After replacement of the PSA (Drawing 2007200) recertification of the ISS shall be as follows:

a. Installation JDC's as required (see 4.3.1),

b. Previbration JDC's 16032, 14033, 14039, 16067, 16075, 16079, 16106, and 16160 (see 6.3).

4.2.2 Inertial Measurement Unit and PIPA Electronics Assembly Tests (IMU or IMU/PEA Repair). Recertification of the IMU/PEA (Drawing No. 2007203) shall be as follows when only the IMU has been repaired or when both the IMU and PEA have been repaired.

a. Previbration JDC's in the Test Flowgram (Figure 1) of ATP 2015497 and vibration in accordance with Specification ND1002274 with the following exceptions:

  (1) Vibration need be performed only along the axis specified in Table II for the part replaced. If no axis is specified, then no vibration or Previbration testing is required.

  (2) Vibration and Previbration testing is required for PIPA and IRIG replacements only if the replacement PIPA or IRIG has not previously been subjected to an equivalent vibration.

  (3) JDC's 16159, 14155, 14156, and 14157 (as applicable) shall be performed only for PIPA or PIPA Electronics replacements.

b. Post vibration JDC's in the test Flowgram (Figure 1) of ATP 2015497 with the following exceptions:

  (1) Exclude JDC's 16079, 16080, 14097, 16098, 16110, and 16246.

  (2) Exclude JDC 16245 when the IMU has not been vibrated. If IMU was vibrated, perform only the temperature control portions.

  (3) Exclude JDC 16017 when the IG, MG, and OG 16X and 1X resolvers (Drawing Number 2018631) and the gyro error resolver (Drawing Number 2018632) have not been replaced.

  (4) Exclude JDC's 16082, 16083, and 16084 when the IG, MG, and OG 16X and 1X resolvers (Drawing Number 2018631) have not been replaced. When replacements are made, perform only the JDC applicable to the resolver replaced.

  (5) Exclude JDC 16108 when the gyro error resolver (Drawing Number 2018632) has not been replaced.

4.2.3 Inertial Measurement Unit and PIPA Electronics Assembly Tests (PEA Repair). Recertification of the IMU/PEA (Drawing 2007203) shall be as follows when only the PEA has been repaired.

a. When the PEA header assembly and modules are replaced, the PEA shall be subject to the following tests.

  (1) Installation JDC's as required (see 4.3.1),

TABLE II (Continued)

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	AXIS OF VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
2021500	IRIG Prealigned Assembly (X)	X*4	16236, 16237 16238, 16179*1
2021500	IRIG Prealigned Assembly (Y)	Y*4	16239, 16240, 16241, 16179*1
2021500	IRIG Prealigned Assembly (Z)	Z*4	16242, 16243, 16244, 16179*1
Wires	Soldered wire joints (10 or less)		*3

*1 Perform only that portion applicable to the unit replaced.
*2 Replace appropriate calibration module.
*3 No JDC's required. Visual inspection necessary for each wire joint. Where 11 or more soldered wire joints are repaired, vibrate as specified by ARRO.
*4 If the PIP or IRIG were replaced after vibration and if the replacement PIP or IRIG were vibrated, the IMU need not be vibrated again.
*5 Exclude all JDC's specified in 4.3.5.2 except JDC 18030.

4.3.5.3 PIPA Electronics Assembly (PEA). Selected testing for the PEA shall be as specified in Table III.

4.3.5.4 Coupling Display Unit (CDU). Selected testing for the CDU shall be as specified in Table IV.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall bein accordance with Specification ND1002214.

6. NOTES

6.1 CSM ISS FLOWGRAM. A test flowgram for the CSM Inertial Subsystem is contained in Figure 1 of Specification ATP2015497.

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4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the ISS shall consist of Recertification Testing or Minimum Retests, but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the replaced assemblies shall be subjected to testing as follows:

4.2.1 Power and Servo Assembly Tests. After replacement of the PSA (Drawing 2007200) recertification of the ISS shall be as follows:

a. Installation JDC's as required (see 4.3.1),

b. Previbration JDC's 16032, 14033, 14039, 16067, 16075, 16079, 16106, and 16160 (see 6.3).

4.2.2 Inertial Measurement Unit and PIPA Electronics Assembly Tests (IMU or IMU/PEA Repair). Recertification of the IMU/PEA (Drawing No. 2007203) shall be as follows when only the IMU has been repaired or when both the IMU and PEA have been repaired.

a. Previbration JDC's in the Test Flowgram (Figure 1) of ATP 2015497 and vibration in accordance with Specification ND1002274 with the following exceptions:

(1) Perform 1X3 IMU vibration as specified in Specification ND1002274, Paragraph 4.3.3 for each repaired or replaced IMU part specified in Table II.

(2) Vibration and Previbration testing is required for PIPA and IRIG replacements only if the replacement PIPA or IRIG has not previously been subjected to an equivalent vibration.

(3) JDC's 16159, 14155, 14156, and 14157 (as applicable) shall be performed only for PIPA or PIPA Electronics replacements.

b. Post vibration JDC's in the test Flowgram (Figure 1) of ATP 2015497 with the following exceptions:

(1) Exclude JDC's 16079, 16080, 14097, 16098, 16110, and 16246.

(2) Exclude JDC 16245 when the IMU has not been vibrated. If IMU was vibrated, perform only the temperature control portions.

(3) Exclude JDC 16017 when the IG, MG, and OG 16X and 1X resolvers (Drawing Number 2018631) and the gyro error resolver (Drawing Number 2018632) have not been replaced.

(4) Exclude JDC's 16082, 16083, and 16084 when the IG, MG, and OG 16X and 1X resolvers (Drawing Number 2018631) have not been replaced. When replacements are made, perform only the JDC applicable to the resolver replaced.

(5) Exclude JDC 16108 when the gyro error resolver (Drawing Number 2018632) has not been replaced.

4.2.3 Inertial Measurement Unit and PIPA Electronics Assembly Tests (PEA Repair). Recertification of the IMU/PEA (Drawing 2007203) shall be as follows when only the PEA has been repaired.

a. When the PEA header assembly and modules are replaced, the PEA shall be subject to the following tests.

(1) Installation JDC's as required (see 4.3.1),

TABLE II

INERTIAL MEASUREMENT UNIT (DRAWING NO. 2018601) TEST METHOD

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	1X3 VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
1001485	Thermostat	Yes	
2007019	Ducosyn Transformer		
2007060	PIP Pre-Amp Assembly (X)		16200, 14201
2007060	PIP Pre-Amp Assembly (Y)		16202, 14203
2007060	PIP Pre-Amp Assembly (Z)		16204, 14205
2007064	Temperature Control Module		
2007170	Temperature Alarm Module		
2007171	Blower Control Module		
2007172	Blower Control Module		
2007204	Precision Resolver Alignment Assembly		16194
2018623	Frameless DC Torque Motor (IG)	Yes	
2018623	Frameless DC Torque Motor (MG)	Yes	
2018624	40 Contact Slip Ring Assembly (MGA)	Yes	16106 [illegible], [illegible]
2018625	Slip Ring Assembly (OGA)	Yes	16106 [illegible], [illegible],
2018629	Frameless DC Torque Motor (OG)	Yes	
2018631	16X and 1X Resolvers (IG)	Yes	16194, 16082
2018631	16X and 1X Resolvers (MG)	Yes	16194, 16083
2018631	16X and 1X Resolvers (OG)	Yes	16194, 16084
2018632	Gyro Error Resolver	Yes	16108
2018634	40 Contact Slip Ring Assembly (IGA)	Yes	16106 [illegible], [illegible]
2018635	Thermostat & Heater	Yes	
2018636	Thermostat Temperature Alarm	Yes	
2018637	Thermostat & Heater Temperature Control	Yes	
2018639	PIP and Capacitor Module (X) *2	Yes*4	16159, 14155, 16200, 14201
2018639	PIP and Capacitor Module (Y) *2	Yes*4	16159, 14156, 16202, 14203
2018639	PIP and Capacitor Module (Z) *2	Yes*4	16159, 14157, 16204, 14205
2018641	Stable Member Heater		
2018644	Variable Speed Blower	Yes	(See below) *5
2018741	Heater & Tapered Mount		
2018823	Thermostat & Heater Temperature Alarm Hi	Yes	
2018824	Thermostat Temperature Alarm Lo	Yes	
2018825	Thermostat & Heater	Yes	
2018826	Thermostat & Heater Temperature Control	Yes	

TABLE II (Continued)

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	1X3 VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
2021500	IRIG Prealigned Assembly (X)	Yes*4	16236, 16237 16238, 16179*1
2021500	IRIG Prealigned Assembly (Y)	Yes*4	16239, 16240, 16241, 16179*1
2021500	IRIG Prealigned Assembly (Z)	Yes*4	16242, 16243, 16244, 16179*1
Wires	Soldered wire joints (10 or less)		*3

*1 Perform only that portion applicable to the unit replaced.

*2 Replace appropriate calibration module.

*3 No JDC's required. Visual inspection necessary for each wire joint. Where 11 or more soldered wire joints are repaired, vibrate as specified by ARRO.

*4 If the PIP or IRIG were replaced after vibration and if the replacement PIP or IRIG were vibrated, the IMU need not be vibrated again.

*5 Exclude all JDC's specified in 4.3.5.2 except JDC 18030.

4.3.5.3 PIPA Electronics Assembly (PEA). Selected testing for the PEA shall be as specified in Table III.

4.3.5.4 Coupling Display Unit (CDU). Selected testing for the CDU shall be as specified in Table IV.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall bein accordance with Specification ND1002214.

6. NOTES

6.1 CSM ISS FLOWGRAM. A test flowgram for the CSM Inertial Subsystem is contained in Figure 1 of Specification ATP2015497.

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TABLE II

INERTIAL MEASUREMENT UNIT (DRAWING NO. 2018601) TEST METHOD

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	1X3 VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
1001485	Thermostat	Yes	
2007019	Ducosyn Transformer		
2007060	PIP Pre-Amp Assembly (X)		16200, 14201
2007060	PIP Pre-Amp Assembly (Y)		16202, 14203
2007060	PIP Pre-Amp Assembly (Z)		16204, 14205
2007064	Temperature Control Module		
2007170	Temperature Alarm Module		
2007171	Blower Control Module		
2007172	Blower Control Module		
2007204	Precision Resolver Alignment Assembly		16194
2018623	Frameless DC Torque Motor (IG)	Yes	
2018623	Frameless DC Torque Motor (MG)	Yes	
2018624	40 Contact Slip Ring Assembly (MGA)	Yes	16106 [illegible]
2018625	Slip Ring Assembly (OGA)	Yes	16106 [illegible]
2018629	Frameless DC Torque Motor (OG)	Yes	
2018631	16X and 1X Resolvers (IG)	Yes	16194, 16082
2018631	16X and 1X Resolvers (MG)	Yes	16194, 16083
2018631	16X and 1X Resolvers (OG)	Yes	16194, 16084
2018632	Gyro Error Resolver	Yes	16108
2018634	40 Contact Slip Ring Assembly (IGA)	Yes	16106 [illegible]
2018635	Thermostat & Heater	Yes	
2018636	Thermostat Temperature Alarm	Yes	
2018637	Thermostat & Heater Temperature Control	Yes	
2018639	PIP and Capacitor Module (X) *2	Yes*4	16159, 14155, 16200, 14201
2018639	PIP and Capacitor Module (Y) *2	Yes*4	16159, 14156, 16202, 14203
2018639	PIP and Capacitor Module (Z) *2	Yes*4	16159, 14157, 16204, 14205
2018641	Stable Member Heater		
2018644	Variable Speed Blower	Yes	(See below) *5
2018741	Heater & Tapered Mount		
2018823	Thermostat & Heater Temperature Alarm Hi	Yes	
2018824	Thermostat Temperature Alarm Lo	Yes	
2018825	Thermostat & Heater	Yes	
2018826	Thermostat & Heater Temperature Control	Yes	

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GFP RETEST SPECIFICATION
FOR
CSM INERTIAL SUBSYSTEM
BLOCK II

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals	
				MIT	NASA

This specification consists of page 1 to 12 inclusive.

APPROVALS	NASA/MSC	W Stameris 6 Apr 67	MIT/IL CCB	R A McKern 3/24/67	H. A. Cook T. A Stone ACSP

4. QUALITY ASSURANCE PROVISIONS

4.1 GENERAL. Testing of the ISS shall consist of Recertification Testing or Minimum Retests, but not both. Additional testing may be specified by the ARRO.

4.2 RECERTIFICATION TESTING. Unless otherwise specified by the ARRO, the replaced assemblies shall be subjected to testing as follows:

4.2.1 Power and Servo Assembly Tests. After replacement of the PSA (Drawing 2007200) recertification of the ISS shall be as follows:

a. Installation JDC's as required (see 4.3.1),

b. Previbration JDC's 16032, 14033, 14039, 16067, 16075, 16079, 16106, and 16160 (see 6.3).

4.2.2 Inertial Measurement Unit and PIPA Electronics Assembly Tests (IMU or IMU/PEA Repair). Recertification of the IMU/PEA (Drawing No. 2007203) shall be as follows when only the IMU has been repaired or when both the IMU and PEA have been repaired.

a. Previbration JDC's in the test flowgram (Figure 1) at ATP2015497,

b. Vibration in accordance with Specification ND1002274, except when either PIPA's or IRIG's that have been vibrated are installed or when parts listed in Table II that do not have an axis of vibration specified are replaced.

c. All post-vibration JDC's in the test flowgram of ATP2015497 (excluding JDC's 16017, 14080, 16082, 16083, 16084, 14097, 16098, 16108, and 16246, and all of JDC 16245 except the temperature control portion) with the following exceptions: When the IG, MG or OG 16X and 1X resolvers (Drawing Number 2018631) are replaced, include JDC 16017, 16082, 16083 or 16084 as applicable; when the gyro error resolver (Drawing Number 2018632) is replaced, include JDC 16017 and JDC 16108.

4.2.3 Inertial Measurement Unit and PIPA Electronics Assembly Tests (PEA Repair). Recertification of the IMU/PEA (Drawing 2007203) shall be as follows when only the PEA has been repaired.

a. When the PEA header assembly and modules are replaced, the PEA shall be subject to the following tests.

   (1) Installation JDC's as required (see 4.3.1),

   (2) Previbration JDC's 16032, 14033, 14039, 16067, and 16106, and adjustment JDC's 14155, 14156, and 14157 as required,

   (3) Vibration in accordance with Specification ND1002274, except that the IMU may be mounted adjacent to the vibration test fixture.

(4) Post-vibration JDC's: JDC 16245 (temperature control portion only) plus installation JDC's as required and then JDC's 16032, 14033, 14039, 16067, 16200, 14201, 16202, 14203, 16204, 14205, 16238, 16241, and 16244.

b. When the PEA header assembly is not replaced, the PEA shall be subjected to the following tests.

(1) Installation JDC's as required (see 4.3.1),

(2) JDC's 16032, 14033, 14039, 16067, 16106, 16200, 14201, 16202, 14203, 16204, 14205, 16238, 16241, and 16244, and adjustment JDC's 14155, 14156, and 14157 as required.

4.2.4 Inertial Measurement Assembly and PIPA Electronics Assembly Tests (IMU/PEA Replacement). Recertification of the ISS after replacement of the IMU/PEA shall be as follows:

a. Installation JDC's as required (see 4.3.1),

b. Post-vibration JDC's 14039, 16067, 16075, 16108, 16110, 16194, 16200, 14201, 16202, 14203, 16204, 14205, 16236, 16237, 16238, 16239, 16240, 16241, 16242, and 16244.

4.2.5 Coupling Data Unit Tests. Recertification of the ISS after replacement of the CDU (Drawing 2007222) shall be accomplished as follows:

a. Installation JDC's as required (see 4.3.1),

b. Post vibration JDC's 16032, 14033, 14039, 14080, 16082, 16083, 16084, 14097, 16098, and 16108 (Vibration shall not be required).

4.3 MINIMUM RETEST. The ISS shall be subjected to the applicable test(s) in this paragraph only when Minimum Retest is specified by NASA/RASPO.

4.3.1 Installation JDC's. The following JDC's shall be performed as required.

a. JDC 16009, IMU and PTA/PEA Mounting Fixture Installation on Rotary Table
b. JDC 16013, IMU Installation on IMU Mounting Fixture
c. JDC 14014, PEA Installation on PEA Holding Fixture
d. JDC 16017, CDU Installation
e. JDC 14018, PSA Installation
f. JDC 14019, Cable and Coolant Hose Connections.

4.3.2 Initial Operating JDC's. The following JDC's shall be performed after all ISS components have been installed on the test pad, prior to the JDC's specified for replaced components as listed in Tables I, II, III, and IV. They shall also be performed if no JDC's are specified.

TABLE II

INERTIAL MEASUREMENT UNIT (DRAWING NO. 2018601) TEST METHOD

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	AXIS OF VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
1001485	Thermostat	Z	
2007019	Ducosyn Transformer		
2007060	PIP Pre-Amp Assembly (X)		16200, 14201
2007060	PIP Pre-Amp Assembly (Y)		16202, 14203
2007060	PIP Pre-Amp Assembly (Z)		16204, 14205
2007064	Temperature Control Module		
2007170	Temperature Alarm Module		
2007171	Blower Control Module		
2007172	Blower Control Module		
2007204	Precision Resolver Alignment Assembly		16194
2018623	Frameless DC Torque Motor (IG)	Y	
2018623	Frameless DC Torque Motor (MG)	Z	
2018624	40 Contact Slip Ring Assembly (MGA)	Z	16106 [illegible]
2018625	Slip Ring Assembly (OGA)	X	16106 [illegible]
2018629	Frameless DC Torque Motor (OG)	X	
2018631	16X and 1X Resolvers (IG)	Y	16194, 16082
2018631	16X and 1X Resolvers (MG)	Z	16194, 16083
2018631	16X and 1X Resolvers (OG)	X	16194, 16084
2018632	Gyro Error Resolver	Y	16108
2018634	40 Contact Slip Ring Assembly (IGA)	Y	16106 [illegible]
2018635	Thermostat & Heater	Z	
2018636	Thermostat Temperature Alarm	Z	
2018637	Thermostat & Heater Temperature Control	Z	
2018639	PIP and Capacitor Module (X) *2	X*4	16159, 14155, 16200, 14201
2018639	PIP and Capacitor Module (Y) *2	Y*4	16159, 14156, 16202, 14203
2018639	PIP and Capacitor Module (Z) *2	Z*4	16159, 14157, 16204, 14205
2018641	Stable Member Heater		
2018644	Variable Speed Blower	Z	(See below) *5
2018741	Heater & Tapered Mount		
2018823	Thermostat & Heater Temperature Alarm Hi	Z	
2018824	Thermostat Temperature Alarm Lo	Z	
2018825	Thermostat & Heater	Z	
2018826	Thermostat & Heater Temperature Control	Z	

TABLE II (Continued)

ASSEMBLY DWG. NO.	PART NAME OF REPAIRED OR REPLACED ITEM	AXIS OF VIBRATION	PERFORM TESTS SPECIFIED IN JDC'S
2021500	IRIG Prealigned Assembly (X)	X*4	16236, 16237 16238, 16179*1
2021500	IRIG Prealigned Assembly (Y)	Y*4	16239, 16240, 16241, 16179*1
2021500	IRIG Prealigned Assembly (Z)	Z*4	16242, 16243, 16244, 16179*1
Wires	Soldered wire joints (10 or less)		*3

*1 Perform only that portion applicable to the unit replaced.
*2 Replace appropriate calibration module.
*3 No JDC's required. Visual inspection necessary for each wire joint.
*4 If the PIP or IRIG were replaced after vibration and if the replacement PIP or IRIG were vibrated, the IMU need not be vibrated again.
*5 Exclude all JDC's specified in 4.3.5.2 except JDC 18030.

4.3.5.3 PIPA Electronics Assembly (PEA). Selected testing for the PEA shall be as specified in Table III.

4.3.5.4 Coupling Display Unit (CDU). Selected testing for the CDU shall be as specified in Table IV.

5. PREPARATION FOR DELIVERY

5.1 GENERAL. Preparation for delivery shall bein accordance with Specification ND1002214.

6. NOTES

6.1 CSM ISS FLOWGRAM. A test flowgram for the CSM Inertial Subsystem is contained in Figure 1 of Specification ATP2015497.

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POST INSTALLATION CHECKOUT PROCESS SPECIFICATION FOR THE APOLLO GUIDANCE & NAVIGATION SYSTEM BLOCK II-KSC

Record of Revisions

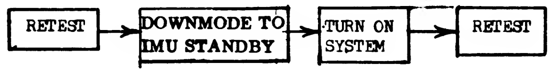
Date	Revision Letter	TDRR No.	Pages Revised	Approvals
5/11/67	A	33750	10-12, 15, 24, 35-46, 51-56, 58-67, 73-78, 81,	
			82, 84-86, 91, 95-97, 99-102, 105-119. Was	
			119 pages, now 120. JK AC	EA

This specification consists of page 1 to 120 inclusive.

APPROVALS	NASA/MSC	2/17/67	ACED

5.4.2 **Failure of the D criteria for IRIG and PIPA parameters.**

5.4.2.1 If D_1, D_2, or D_3 exceeds its maximum value as specified in Table D of 6.2.16.10.7 for any IRIG or PIPA, that IRIG or PIPA shall be retested in the sequence indicated below. The coefficient stability terms shall be recalculated.



RETEST SEQUENCE

If D_1, D_2, or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2 (IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1, D_2, and D_3 are within the tolerances specified in Table D of 6.2.16.10.8 after the retest sequence is completed, the original out-of-tolerance D terms calculated in 6.2.16.10.8 shall be exonerated.

5.4.2.2 **Stability Requirements**

5.4.2.2.1 Failure to be within the maximum values for D_1, D_2, or D_3 after the retest sequence shall constitute failure of the unit.

5.5 Retest subsequent to replacement of a malfunctioned assembly with that of a flight certified assembly shall be at the discretion of NASA Engineering. Table II can be used as a guide to determine general retest requirements. In all retest procedures, the test sequence of Figure 1 shall be adhered to.

5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.

5.7 The following requirements shall be completed before any of the tests in this specification are attempted.

5.7.1 The G&N System shall have been qualified in accordance with the requirements of PS2015000.

5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II MA0308-0107.

5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.

5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

TABLE II. RETEST MATRIX

Paragraph Number	Test Title	IMU	NAV BASE	OPTICS	CMC	PSA	LEB DSKY	MDC DSKY	SIG. COND.	CDU	G&N HARNESS	PIPA ELECT.	INDICATOR CONTROL PANEL
6.1.3	Pre-Power Application Tests	X	X	X	X	X	X	X	X	X	X	X	X
6.2.1	Application of Standby Power to G&N System	X	X		X	X	X	X	X	X	X	X	
6.2.5	General Turn Off and Turn On Procedure	*		*	*	*	*	*	*	*	*	*	*
6.2.3	Operate Power On Test	X	X		X	X			X	X	X	X	
6.2.2	CMC Operational Test				X		X	X		X	X		X
6.2.8	G&N Panel Brightness and Lamp Test	X	X	X		X					X		X
6.2.6	G&N Operational Test	X	X		X	X				X	X	X	
6.2.10	Zero Optics Test		X	X	X	X			X	X	X		X
6.2.13	Optics Slew Rate Test		X	X	X	X			X	X	X		X
6.2.11	Optics Coordinate Transformation Control		X	X		X					X		X
6.2.12	Optics Positional Accuracy Test		X	X	X	X				X	X		X
6.2.9	Semi-Automatic Mode Control Test	X	X	X	X	X			X	X	X		
6.2.14	Stab Loop Step Response Test	X	X			X			X				
6.2.15	IRIG Scale Factor Test	X	X			X							
6.2.16	IMU Performance Test	X	X			X						X	
6.2.17	Fine Alignment Test	X	X	X	X					X	X		
6.2.19	Voltage Margin Test				X					X	X		
6.2.7	Gimbal Friction Test	X	X						X		X		
6.2.18	Gyrocompassing Test**	X	X			X						X	
6.2.4	G&N Power Supplies Test		X		X	X			X	X	X	X	
6.2.21	S/C Control & Display Test				X					X	X		

* To be used as necessary to turn system on and off.
** If gyrocompassing test is performed as part of a retest activity, it shall be performed for a total of [illegible] hours including the 2 hour settling period.

6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. 513-100. The temperature of the IRIG's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MNA, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period, but not less than 15 minutes, shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

6.2 **Test Procedures**

6.2.1 Application of Standby Power to G & N System

6.2.1.1 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.

6.2.1.2 The Inertial Component Temperature Controller (ICTC), shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.

6.2.1.3 Computer Power On

6.2.1.3.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).

6.2.1.3.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.

6.2.1.3.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.

6.2.1.3.4 **The +28 VDC CMC OPERATE voltage (CG 1520) shall be +28.8±3 VDC. Verify CRT indication.** [illegible] voltage [illegible]) shall be +28.0 ± 3 [illegible]. [illegible]

6.2.1.3.5 Using DSKY, enter VERB 36, ENTR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.

6.2.1.3.6 The voltage output of the +4 VDC CMC supply shall be +4.00 ± 0.20 VDC, (CG 1030). The value on the CRT shall be recorded.

6.2.1.3.7 The voltage output of the +14 VDC CMC supply shall be +14.0 ± 0.4 VDC, (CG 1020). The value on the CRT shall be recorded.

[illegible] Verify that [illegible] CMC is [illegible] on the CRT [illegible] indicates [illegible], and the [illegible] on the [illegible] C and LEB [illegible].

6.2.2.12 CMC Clock Frequency Test

6.2.2.12.1 Insure that the CMC has been operating for at least 15 min. before performing this test.

6.2.2.12.2 Insure that the IMU 3.2 kc 28 V Supply is available on the vertical input to PIPA Scope.

6.2.2.12.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.

6.2.2.12.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.

6.2.2.12.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.

6.2.2.12.5 Set the preset counter to indicate 96000.

6.2.2.12.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).

6.2.2.12.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.

6.2.2.12.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.

6.2.2.12.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result.

6.2.2.12.10 Divide 96000 by the average time from 6.2.2.11.9. Record the result as 3200 cps frequency.

6.2.2.12.11 Multiply the 3200 cps frequency by 640. Record the results as the CMC clock frequency.

6.2.2.12.11.1 The CMC Clock Frequency shall be 2048000 ± 5 cps.

6.2.2.13 Minimum Impulse Controller Input Test.

6.2.2.13.1 Enter the following into the DSKY.

a. VERB 11 NOUN 10, ENTER

b. 00032, ENTER

6.2.2.13.2 Set the Minimum Impulse Controller on the Indicator Control Panel to the following position and observe R1 of the DSKY for the proper indications.

MIC Position	R1 DSKY Indication
a. Up	77775
b. Down	77776
c. Left	77737
d. Right	77757
e. Clockwise	77773
f. Counterclockwise	77767
g. Neutral	77777

6.2.2.13.3 Enter VERB 34, ENTER into the DSKY.

6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power ON

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of Step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)
b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

e. G/N Power - IMU set to OFF
f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G&N Indicator control panel shall be set as follows:

a. OPTICS MODE to MANUAL
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to MED
d. TELESCOPE TRUNNION to SLAVE to SXT
e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G&N Displays.

6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

a. CG 2117 IGA Servo Error In Phase

b. CG 2177 OGA Servo Error In Phase

c. CG 2147 MGA Servo Error In Phase

d. CG 2112 IG IX Resolver Output Sin

e. CG 2172 OG IX Resolver Output Sin

f. CG 2142 MG IX Resolver Output Sin

g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G&N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

a. Turn on the IMU MNA and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

b. Start Analog Recorders.

c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

a. The IMU Operate Power is +28.8 ± 3VDC (CG 1500). Verify on CRT.

b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin

CG 2142, MG IX Resolver Output Sin

CG 2172, OG IX Resolver Output Sin

c. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90 ± 10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read +120 ± 6 VDC.

d. Stop the analog recorders.

6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.

a. CMC Warning
b. ISS Warning
c. PGNS Caution

6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000±00150. Verify on CRT.

6.2.3.1.10 Enter the following into K-148:

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

TABLE VI. SECONDARY POWER SUPPLY VOLTAGES

Meas. No.	Signal
1. CG 1040	+120 VDC PIPA SUPPLY
2. CG 1051	+20 VDC PIPA SUPPLY
3. CG 1052	-20 VDC PIPA SUPPLY
4. CG 1070	+4 VDC CDU SUPPLY
5. CG 1100	-28 VDC ELECTRONICS
6. CG 1020	+14 VDC CMC SUPPLY
7. CG 1030	+4 VDC CMC SUPPLY
8. CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9. CG 1202	IMU 28V 800 CPS 5 pct ph A
10. CG 1203	IMU 28V 800 CPS 5 pct ph B
11. CG 1331	3.2KC 28V SUPPLY
12. CG 1110	2.5 VDC TM BIAS

6.2.3.1.12 15 minutes after the application of IMU OPERATE power record PIPA TEMP (CG 2300) displayed on the CRT.

6.2.3.1.13 30 minutes after the application of IMU OPERATE power record IRIG TEMP (CG 2301) displayed on the CRT.

6.2.3.1.14 1 hour after the application of IMU OPERATE power monitor and record PIPA TEMP (CG 2300) and IRIG TEMP (CG 2301) every 5 minutes for 1 hour. Verify that each reading does not deviate from the average of each signal by more than 0.1°F.

6.2.3.1.15 When 2 hours have elapsed since the application of IMU OPERATE power record PIPA TEMP and IRIG TEMP. PIPA TEMP shall be 130.5±1.5°F. IRIG TEMP shall be 135±2.5°F. PIPA TEMP shall be within 0.5°F of that recorded in 6.2.3.1.12 and 6.2.1.5.4. IRIG TEMP shall be within 0.5°F of that recorded in 6.2.3.1.13.

6.2.3.2 Optics Power ON

6.2.3.2.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power - OPTICS switch on the LEB Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is +28.8±3 VDC. Record the indication on the CRT.

6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:

CG 1211	OPTX 28V 800 CPS 1 pct 0 ph
CG 1212	OPTX 800 CPS 5 pct-90 ph

6.2.3.3 IMU Cage Test

6.2.3.3.1 Enter the following into the DSKY:

a. VERB 40 NOUN 20, ENTER (wait 3 seconds)
b. VERB 41 NOUN 20, ENTER
c. +00200, ENTER
d. +00200, ENTER
e. +00200, ENTER

Observe that the NO ATT lamps on the DSKY's light and that CDUX, CDUY, CDUZ on the CRT indicate approximately +00200.

6.2.3.3.2 Set up the Analog Recorder to monitor the following signals:

a. IG 1X Resolver Output Sine (CG 2112)
b. MG 1X Resolver Output Sine (CG 2142)
c. OG 1X Resolver Output Sine (CG 2172)

Start the Analog Recorders.

6.2.3.3.3 On MDC panel 1, press and hold the IMU CAGE switch in the CAGE position. On the Analog Recorder, verify that the 1X Sine signals (CG 2112, CG 2142, and CG 2172) null out at 0.5V rms or less.

6.2.3.3.4 Release the IMU CAGE switch. Disregard any momentary transients on the 1X Resolver Sine signals when the switch is released. Sustained oscillations shall be cause for immediate removal of IMU OPERATE power.

6.2.3.3.5 On the CRT verify that CDUX, CDUY and CDUZ are all between +00150 and +35850.

6.2.3.3.6 Stop the Analog Recorders.

6.2.4 G&N System Power Supplies Test

6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.

6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER; +00000 ENTER.

6.2.4.3 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breakers Panel and LEB.

a. COMPUTER MN A to ON (pushed in) and COMPUTER MN B to OFF (pulled out).
b. G/N - POWER to AC1
c. IMU HTR MN A to ON (pushed in) and IMU HTR MN B to OFF (pulled out).
d. IMU MN A to ON (pushed in) and IMU MN B to OFF (pulled out).
e. G/N POWER - IMU to IMU
f. OPTICS MN A to ON (pushed in) and OPTICS MN B to OFF (pulled out).
g. G/N POWER - OPTICS to OPTICS

6.2.4.4 Record the voltage indicated on the CRT for the following signals:

a. The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be +28.8±3 VDC (CG 1500).
b. The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be +28.8±3 VDC (CG 1510).
c. The +28 VDC CMC OPERATE (Buss No. 3) output voltage shall be +28.8±3 VDC (CG 1520).
d. The +28 VDC OPTX OPERATE (Buss No. 4) output voltage shall be +28.8±3 VDC (CG 1530)

6.2.4.5 Record the voltage indicated on the CRT for the following power supplies:

a. The +120 VDC PIPA Power Supply output voltage shall be 120±6 VDC (CG 1040).
b. The +20 VDC PIPA Power Supply output voltage shall be 20.0±1.2 VDC (CG 1051).
c. The -20 VDC PIPA Power Supply output voltage shall be -20±2 VDC (CG 1652).
d. The -28 VDC Electronics Power Supply output voltage shall be -28.5±6.0 VDC (CG 1100).

6.2.4.6 The following values shall be measured with the guidance reference clock synchronizing input pulse. Record the voltage indicated on the CRT.

a. IMU 28V, 800 CPS 1% 0 deg voltage shall be 28.0±0.6 VAC (CG 1201)
b. IMU 28V, 800 CPS, 5% PHA - 90 deg. voltage shall be 28.0±1.4 VAC (CG 1202).
c. IMU 28V, 800 CPS, 5% PHB 0 deg. voltage shall be 28.0±2.1 VAC (CG 1203).
d. Optics 28V, 800 CPS 1% 0 deg voltage shall be 28.0±0.6 VAC (CG 1211).
e. Optics 28V, 800 CPS 5% -90 deg voltage shall be 28.0±1.5 VAC (CG 1212).

6.2.4.7 Record the voltages indicated on the CRT for the following power supplies:

a. The +14 VDC CMC Power Supply output voltage shall be +14.0±0.4 VDC (CG 1020).
b. The +4 VDC CMC Power Supply output voltage shall be +4.0±0.2 VDC (CG 1030).
c. The +4 VDC CDU Power Supply output voltage shall be +4.0±0.2 VDC (CG 1070).
d. The +2.50 VDC TM BIAS SUPPLY output voltage shall be +2.50±0.05 VDC (CG 1110).

6.2.4.8 Record the CRT indications for the following measurements:

a. The 28V, 3200 CPS Power Supply feedback output voltage shall be 28.6±0.6V RMS (CG 1331).
b. The phase difference between the 3.2Kc supply and CMC sync shall be 0° ±10° (CG 1336).
c. The +14 VDC CMC Power Supply RMS noise shall be less than 0.4 volts p-p (CG 1021).
d. The +4 VDC CMC Power Supply noise peaks shall be less than 0.4 volts p-p (CG 1031).

6.2.4.9 Set/Verify the following circuit breakers and switches on the Right Hand Circuit Breaker Panel and LEB:

a. G/N POWER-OPTICS to OFF
b. OPTICS MN B to ON (pushed in) and OPTICS MN A to OFF (pulled out)
c. G/N POWER - IMU to OFF
d. IMU MN B to ON (pushed in) and IMU MN A to OFF (pulled out).
e. IMU HTR MN A to OFF (pulled out).
f. G/N - POWER to OFF
g. COMPUTER MN B to ON (pushed in) and COMPUTER MN A to OFF (pulled out)

6.2.4.10 Verify that the +28 VDC CMC OPERATE output voltage is +28.8±3 VDC (CG 1520).

6.2.4.11 Set the G/N - POWER switch on the LEB to AC2. Set the IMU HTR MN B to ON (pushed in). Verify that the +28 VDC IMU STANDBY output voltage is +28.8±3 VDC (CG 1500).

6.2.4.12 Wait until 15 minutes have elapsed since setting G/N POWER - IMU to OFF in 6.2.4.9.c then set the G/N POWER - IMU to IMU. Verify that the +28 VDC IMU OPERATE output voltage is +28.8±3 VDC (CG 1500).

6.2.4.13 Set the G/N POWER - OPTICS to OPTICS. Verify that the +28 VDC OPTX OPERATE output voltage is +28.8±3 VDC (CG 1530).

6.2.4.14 Repeat 6.2.4.5 through 6.2.4.8.

6.2.4.15 Set the following circuit breakers to the position indicated:

a. Set the COMPUTER MN A to ON (pushed in).
b. Set the IMU HTR MN A to ON (pushed in).
c. Set the IMU MN A to ON (pushed in).
d. Set the OPTICS MN A to ON (pushed in).

6.2.4.16 Miscellaneous Checks - The following miscellaneous signals are required to supply data for system evaluation in the event of failure, or for trend analysis of system performance. Record the values displayed on the CRT for the following signals.

a.	CG 4300	CMC Temperature
b.	CG 6020	PIPA Calibration Module Temperature
c.	CG 6021	IMU 800 CPS 5% Temperature

6.2.4.17 Set the G/N POWER -OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure.

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

a. VERB 41 NOUN 20, ENTER

b. +00000 ENTR

c. +00000 ENTR

d. +09000 ENTR

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

a. OPTICS MODE to MANUAL

b. CONTROLLER MODE to DIRECT

c. CONTROLLER SPEED to MED

d. TELESCOPE TRUNNION to SLAVE TO SXT

e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 **Set the PSAAM power switch on the PSAAM to OFF.**

6.2.5.1.6 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.7 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.8 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).

6.2.5.1.9 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right. Hand Circuit breaker panel to OFF.

6.2.5.1.10 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.

a. G&N ON(PTC inhibit) light not illuminated.

b. IMU Temp/heater current meter indicates IMU temperature of 130°±5°F.

6.2.5.2 Turn ON Procedure

6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.

a. CONDITION LAMPS to ON

b. OPTICS MODE to MANUAL

c. CONTROLLER COUPLING to DIRECT

d. CONTROLLER SPEED To DIRECT

e. TELESCOPE TRUNNION to SLAVE to SXT

f. RETICLE BRIGHTNESS to minimum brightness position.

6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.

CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

6.2.5.2.3 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). If the STBY indicator on the DSKY is illuminated, press the STBY pushbutton for approximately 3 seconds until the STBY indicator extinguishes. Enter VERB 61 into K148 and press the ENTER pushbutton. Verify +14 and +4 VDC AGC power supply outputs on CRT display. Voltages shall be +14±0.4V (CG 1020) and +4±0.2 (CG 1030).

6.2.5.2.4 Energize the G&N IMU HTR, MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523).

6.2.5.2.5 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.

6.2.5.2.5.1 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand Circuit breaker panel and LEB Lighting Control panel.

6.2.5.2.5.2 Set/Verify the following switches on the PSAAM.

a. PSAAM Power to On
b. INHIBIT VOLTAGE FAIL to OFF.

6.2.5.2.6 Disregard all alarm indications on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbutton on K148. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.

6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start.

a. VERB 57, press ENTER
b. 00015, press ENTER

6.2.5.2.8 Initiate CMC self-check by entering the following sequence into the K-Start:

a. VERB 21 NOUN 27, ENTER

b. 77777, ENTER

c. VERB 05 NOUN 01, ENTER

d. 1366, ENTER

6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT +2) increment twice. If an error is detected, the following will be displayed:

VERB 05 NOUN 31

R1 = 01102 or 41102

R2 = XXXXX c (S Fail)

R3 = XXXXX c (ERcount)

6.2.5.2.8.2 Enter the following into the K-Start:

a. VERB 21

b. NOUN 27 ENTER

c. 00000, ENTER

NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0°, 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.

b. If the G&N System has been turned off with the gimbals in the unparked position for less than 2 hours allow a warmup time equal to the time off but not less than 15 minutes to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9 After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the IMU position (toggle up).

6.2.7 Gimbal Friction Test

6.2.7.1 Perform Master Initialization, 6.2.5.3, before proceeding.

6.2.7.2 Inner Gimbal Friction Test

6.2.7.2.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

a. CG 2120	IG TORQUE MOTOR CURRENT
b. CG 2117	IGA SERVO ERROR IN PHASE
c. CG 2112	IG 1X RESOLVER OUTPUT SIN
d. CG 2113	IG 1X RESOLVER OUTPUT COS
e. CG 2220	IGA CDU FINE ERROR

6.2.7.2.2 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing).

a. VERB 24 NOUN 01, ENTER
b. 00407, ENTER
c. 40000, ENTER
d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.2.3 Enter the following sequence into K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (verify VERB 33 on CRT)

6.2.7.2.4 Start analog recorders.

6.2.7.2.5 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders. During this period monitor IG TORQUE MOTOR CURRENT (CG 2120) on the CRT.

6.2.7.2.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40, NOUN 20, press ENTER
b. VERB 41, NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. +00000, press ENTER

6.2.7.2.7 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding .

6.2.7.2.8 Enter the following sequence into the K-Start. Push the ENTER push button after each entry (-360° IG torquing):

a. VERB 24 NOUN 01 ENTER
b. 00407, ENTER
c. 37777, ENTER
d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.2.9 Enter the following sequence into K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (Verify VERB 33 on CRT).

6.2.7.2.10 Start analog recorders.

6.2.7.2.11 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.2.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40, NOUN 20, press ENTER
b. VERB 41, NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. +00000, press ENTER

6.2.7.2.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

6.2.7.3 Outer Gimbal Friction Test.

6.2.7.3.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

a.	CG 2180	OG TORQUE MOTOR CURRENT
b.	CG 2177	OGA SERVO ERROR IN PHASE
c.	CG 2172	OG 1X RESOLVER OUTPUT SIN
d.	CG 2173	OG 1X RESOLVER OUTPUT COS
e.	CG 2280	OGA CDU FINE ERROR

6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER pushbutton after each entry (+360° OG torquing):

a. VERB 24 NOUN 01, ENTER
b. 00405, ENTER
c. 40000, ENTER
d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.3 Enter the following sequence into K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (verify VERB 33 on CRT)

6.2.7.3.4 Start analog recorders

6.2.7.3.5 Observe measurement CG 2172, OG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders. During this period monitor OG TORQUE MOTOR CURRENT (CG 2180) on the CRT.

6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40, NOUN 20, press ENTER
b. VERB 41, NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. +00000, press ENTER

6.2.7.3.7 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 30 seconds before proceeding.

6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (-360° OG torquing):

a. VERB 24 NOUN 01, ENTER
b. 00405, ENTER
c. 37777, ENTER
d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement CG 2172, OG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start:

a. VERB 40, NOUN 20, press ENTER
b. VERB 41, NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 30 seconds before proceeding.

6.2.7.4 Middle Gimbal Friction Test.

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

a.	CG 2150	MG TORQUE MOTOR CURRENT
b.	CG 2147	MGA SERVO ERROR IN PHASE
c.	CG 2142	MG 1X RESOLVER OUTPUT SIN
d.	CG 2143	MG 1X RESOLVER OUTPUT COS
e.	CG 2250	MGA CDU FINE ERROR

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

a. VERB 24, NOUN 01, ENTER
b. 00411, ENTER
c. 63777, ENTER
d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs (approximately 5 minutes), stop the recorders. During this 5 minute period monitor MG TORQUE MOTOR CURRENT (CG 2150) on the CRT.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40 NOUN 01, ENTER
b. VERB 41 NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

a. VERB 24 NOUN 01, ENTER

b. 00411, ENTER

c. 14000, ENTER

d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.9 Enter the following sequence in the K-Start:

a. VERB 42, press ENTER

b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs (approximately 5 minutes), stop the recorders. [illegible].

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40 NOUN 20, press ENTER

b. VERB 41 NOUN 20, press ENTER

c. +00000, press ENTER

d. +00000, press ENTER

e. +00000, press ENTER

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere. The CDU Fine Error measurements shall not exceed ±70 mv rms.

6.2.9 **Semi-Automatic Moding Check**

Proceed with this test if 6.2.2.2.2 or 6.2.4 has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 before proceeding with this test.

6.2.9.1 Test Initiation

6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify OPTX BUS, 28V 800 ~ 1% and 5% Power Supplies.

6.2.9.1.2 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.

6.2.9.1.4 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.

6.2.9.2 Enter VERB 33 and press ENTER. The NO ATT lamp on the DSKY's shall light. After approximately 30 seconds the following data shall be displayed on the CRT:

a. VERB 06 NOUN 02 flashing
b. R1 = +00000 ± 00007
c. R2 = +00000 ± 00007
d. R3 = +00000 ± 00007
e. IG angle = 000 ± 1 deg.
f. MG angle = 000 ± 1 deg.
g. OG angle = 000 ± 1 deg.

6.2.9.3 Enter VERB 33 and press ENTER. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 03 flashing
b. R1 = +04500 ± 00007
c. R2 = +04500 ± 00007
d. R3 = +04500 ± 00007
e. IG angle = 045 ± 1 deg.
f. MG angle = 045 ± 1 deg.
g. OG angle = 045 ± 1 deg.

6.2.9.4 Enter VERB 33 and press ENTER. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing
b. R1 = 00000 ± 00003
c. R2 = 00000 ± 00003
d. R3 = 00000 ± 00003

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

6.2.9.5 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT. The PGNS Caution lamp on the Indicator Control Panel shall light.

a. VERB 06 NOUN 05 flashing
b. R1 = +07100 ± 00007
c. R2 = +07100 ± 00007
d. R3 = +07100 ± 00007
e. IG angle = 071 ± 1 deg.
f. MG angle = 071 ± 1 deg.
g. OG angle = 071 ± 1 deg.

The GIMBAL LOCK lamps on the DSKY's shall light.

6.2.9.6 Enter VERB 33 and press ENTER. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 06 Flashing
b. R1 = +09000 ± 00007
c. R2 = +09000 ± 00007
d. R3 = +09000± 00007
e. IG angle = 090 ± 1 deg.
f. MG angle = 090 ± 1 deg.
g. OG angle = 090 ± 1 deg.

6.2.9.7 Enter VERB 33 and Press ENTER. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 07
b. R1 =+13500 ± 00007
c. R2 = +13500 ± 00007
d. R3 = +13500 ± 00007
e. IG angle = 135 ± 1 deg.
f. MG angle = 135 ± 1 deg.
g. OG angle = 135 ± 1 deg.

6.2.9.8 Enter VERB 33 and press ENTER. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's. The PGNS Caution lamp on the Indicator Control Panel shall extinguish.

6.2.9.9 Enter VERB 33 and press ENTER. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing.
b. R1 = 00000 ± 00003
c. R2 = 00000 ± 00003
d. R3 = 00000 ± 00003

6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT. The PGNS caution lamp on the Indicator Control Panel shall light.

a. VERB 06 NOUN 12 flashing
b. R1 = +22500±00007
c. R2 = +22500±00007
d. R3 = +22500±00007
e. IG angle = 225±1 deg.
f. OG angle = 225±1 deg.
g. OG angle = 225±1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.11 Enter VERB 33 and press ENTER. After approximately 20 seconds the following data shall be displayed on the CRT. The PGNS caution lamp on the Indicator Control Panel shall extinguish.

a. VERB 06 NOUN 13 flashing
b. R1 = +22500±00007
c. R2 = +22500±00007
d. R3 = +31500±00007
e. IG angle = 225±1 deg.
f. OG angle = 225±1 deg.
g. MG angle = 315±1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish.

6.2.9.12 Enter VERB 33 and press ENTER. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing
b. R1 = 00000±00003
c. R2 = 00000±00003
d. R3 = 00000±00003

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 15 flashing
b. R1 = +31500±00007
c. R2 = +31500±00007
d. R3 = +31500±00007
e. IG angle = 315±1 deg.
f. MG angle = 315±1 deg.
g. OG angle = 315±1 deg.

6.2.9.14 Enter VERB 33 and press ENTER. The NO ATT lamp on the DSKY's shall extinguish. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing
b. R1 = 00000±00003
c. R2 = 00000±00003
d. R3 = 00000±00003

6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. After approximately 20 seconds the following data shall be displayed on the CRT. The PGNS Caution lamp on the Indicator Control Panel shall light.

a. VERB 06 NOUN 17 flashing
b. R1 = +28900±00007
c. R2 = +28900±00007
d. R3 = +28900±00007
e. IG angle = 289±1 deg.
f. OG angle = 289±1 deg.
g. MG angle = 289±1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.16 Enter VERB 33 and press ENTER. After approximately 20 seconds the following data will be dislpayed on the CRT. The PGNS Caution lamp on the Indicator Control Panel shall extinguish.

a. VERB 06 NOUN 20 flashing
b. R1 = +00000±00007
c. R2 = +00000±00007
d. R3 = +00000±00007
e. IG angle = 000±1 deg.
f. MG angle = 000±1 deg.
g. OG angle = 000±1 deg.

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

6.2.9.17 Enter VERB 33 and press ENTER. The COMP ACTY lamp on the DSKY's shall flash for a few seconds. After approximately 15 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66 flashing
b. R1 = 000xx
c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall light. The PGNS Caution lamp on the Indicator Control Panel shall light.

Record R1 and R2 as the Middle Gimbal CDU drive rate. MG rate = R1 · R2 ° /sec. The Middle Gimbal CDU drive rate shall be 14±2° /sec.

6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66 flashing
b. R1 = 000xx
c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall extinguish. The PGNS Caution lamp on the Indicator Control Panel shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.
IG rate = _R1_ . _R2_ °/sec. The Inner Gimbal CDU drive rate shall be 14±2° /sec.

6.2.9.19 Enter VERB 33 into K148.. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66 flashing
b. R1 = 000xx
c. R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate.
OG rate = _R1_ . _R2. °/sec. The Outer Gimbal CDU drive rate shall be 14±2° /sec.

6.2.9.20 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall extinguish. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 glashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxx.

The ISS WARNING Lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.21 Enter VERB 33 into K148. Press the ENTER pushbutton. ISS WARNING and ISS CDU FAIL shall be OFF. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. The NO ATT lamp on the DSKY's shall momentarily light, then extinguish. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton.
Verify R1 = 33xxx.

The ISS WARNING lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. The NO ATT lamp on the DSKY's shall light. VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.

6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

6.2.9.24 Enter VERB 33, press ENTER. After approximately 25 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66 flashing

b. R1 = 000xx

c. R2 = xxxxx

Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = R1 . R2 . The Shaft Optics CDU drive rate shall be 7.32 ± 1.82°/sec.

6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66

b. R1 = 0000x

c. R2 = xxxxx

Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = R1 . R2 . The Trunnion Optics CDU drive rate shall be 1.83 ± 0.50°/sec.

6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Observe PROG display on DSKY's is 00. Press the ENTER pushbutton. Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.10 Zero Optics Test

6.2.10.1 Set the G&N POWER-OPTICS switch on the LEB to OPTICS. Verify Power Supplies.

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2 Turn On procedure before proceeding.

6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

a. TELESCOPE TRUNNION to SLAVE to SXT
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to HI

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the CRT.

a. R1 = +000.00 ± 000.03 (Shaft Angle)
b. R2 = +00.000 ± 00.006 (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.

a.	CG 3140	SXT Shaft Tach Output
b.	CG 3150	SXT Trunnion Tach Output
c.	CG 3160	SCT Shaft Tach Output
d.	CG 3170	SCT Trunnion Tach Output
[illegible]	[illegible]	[illegible] Control [illegible]
e.	CG 31[illegible]0	[illegible] Shaft Tach Output
f.	[illegible]	SCT Trunnion [illegible] Output

6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the CRT indicates +180±1°. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the CRT indicates +75±1°.

6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds. The peak magnitude of the SXT Shaft (CG 3140) and Trunnion (CG 3150) Tach Outputs shall be 3.3±1.3V rms. The peak magnitude of the SCT Shaft Tach Output (CG 3160) shall be 3.3±1.3V rms. The peaks magnitude of the SCT Trunnion Tach Output (CG 3170) shall be 0.85±0.35V rms.

6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:

a. R1 = 000.00±000.03
b. R2 = 00.000±00.006

6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0±0.11 degrees. The Trunnion Angle shall be 0.0±0.22 degrees.

6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN.

NOTE: If optics testing will not be continued, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.11 OPTICS Coordinate Transformation Control Test

6.2.11.1 Set the G/N POWER-OPTICS switch on the LEB to OPTICS. Verify Power Supplies.

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

a. VERB 41 NOUN 20, ENTER

b. +00000, ENTER

c. +00000, ENTER

d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

a. TELESCOPE TRUNNION to SLAVE TO SXT

b. CONTROLLER COUPLING to DIRECT

c. CONTROLLER SPEED TO HI

6.2.11.4 Enter the following into the K-Start to monitor the OPTICS CDU's

VERB 16 NOUN 55, press ENTER

6.2.11.5 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Insure that the Optics zero properly by observing that R1 and R2 of the CRT indicate as follows:

a. R1 = +000.00 ± 000.03 (Shaft Angle)

b. R2 = +00.000 ± 00.006 (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.11.6 Set up the analog recorders to monitor the following measurements:

a. CG 3160 SCT Shaft Tachometer Output

b. CG 3170 SCT Trunnion Tachometer Output

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = +225.00 and R2= +10.000 on the CRT and the DSKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and the controller speed switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.

6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. Release the control stick when the target leaves the SCT upper right field of view, and immediately record the shaft angle as displayed on R1 of the CRT and DSKY's. The recorded shaft angle shall be +225 ± 10.00 degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be from 24 to 36 seconds.

6.2.11.12 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero, Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12.9.10 Sight through the SXT. The StLOS should be centered on Optical Target No. 2. Record the Shaft and Trunnion angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.9.5 shall be less than 0.25 degrees. Record the difference.

6.2.12.9.11 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

6.2.13 Optic Slew Rate Test

6.2.13.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.13.2 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify the following signals on the CRT.

a. +28 VDC OPTICS OPERATE BUS (CG 1530) is +29.0±3.0 VDC.
b. OPTX 28V 800 cps 1% 0° ph not flashing on the CRT
c. OPTX 28V 800 cps 5% -90° ph not flashing on the CRT

6.2.13.3 Deleted.

6.2.13.4 Deleted.

6.2.13.5 Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.13.6 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following data displayed in R1 and R2 on the DSKY.

a. R1 = +000.00±000.03 (Shaft Angle)
b. R2 = +00.000±00.0006 (Trunnion LOS Angle)

Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

NOTE: Read and understand step 6.2.13.7 before proceeding.
Do not hold Control Stick at upper limit more than 10 seconds or exceed a trunnion angle of 85°.

Trunnion Slew Rate - HI Speed

6.2.13.7 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:

a. R2 = $\pm$ XX.XXX (Trunnion LOS angle in deg.)
b. R3 = $\mp$ XXX.XX (Time in seconds)

6.2.13.8 Perform the following calculations:

a. Difference between R2 displays = _ _ _ _ _ (trun. angle)
b. Difference between R3 displays = _ _ _ _ _ (time)
c.

$$\frac{\text{trun. angle}}{\text{time}} = \_\_ \text{ deg/sec}$$

The Trunnion slew rate shall be 10.0 ± 2.0 deg/sec.

Shaft Slew Rate - HI Speed

6.2.13.9 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.10 before proceeding.
Do not hold Control Stick at right limit for more than 10 seconds or exceed a shaft angle of 250°.

6.2.13.10 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

R1 = $\pm$ XXX.XX (Shaft angle in deg.)
R3 = $\mp$ XXX.XX (Time in seconds)

6.2.13.11 Perform the following calculations

a. Difference between R1 displays = _ _ _ _ _ (shaft angle)
b. Difference between R3 displays = _ _ _ _ _ (time)
c.

$$\frac{\text{shaft angle}}{\text{time}} = \_\_\_ \text{ deg/sec}$$

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec.

Trunnion Slew Rate - MED Speed

6.2.13.12 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read and understand 6.2.13.13 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.13 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:

a. R2= + XX.XXX (Trunnion LOS Angle in degrees)
b. R3= + XXX.XX (Time in seconds)
c. $\frac{\text{Trunnion angle}}{\text{Time}}$ = _._ _ deg/sec

The Trunnion slew rate shall be 1.0 ± 0.2 deg/sec.

Shaft Slew Rate - MED Speed

6.2.13.15 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.16 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.16 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

a. R1 = +XXX.XX (Shaft Angle in degrees)
b. R3 = +XXX.XX (Time in seconds)

6.2.13.17 Perform the following calculations

a. Difference between R1 displays = ______ (Shaft Angle)
b. Difference between R3 displays = ______ (Time)
c.

$$\frac{\text{Shaft Angle}}{\text{Time}} = \_.\_\_ \text{ deg/sec}$$

The Shaft Slew Rate shall be 2.0 ± 0.4 deg/sec.

Trunnion Slew Rate - LO Speed

6.2.13.18 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.19 before proceeding. Do nothold control stick at upper limit for more than 30 seconds.

6.2.13.19 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R2 and R3. The data displayed is in the following form:

a. R2= +XX.XXX (Trunnion LOS Angle in degrees)
b. R3= +XXX.XX (Time in seconds)

6.2.13.20 Perform the following calculations

a. Difference between R2 displays = XX.XXX (Trunnion Angle)
b. Difference between R3 displays = XXX.XX (Time)
c.

$$\frac{\text{Trunnion Angle}}{\text{Time}} = \_.\_\_ \text{ deg/sec}$$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

Shaft Slew Rate - LO Speed

6.2.13.21 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.22 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.22 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first MARK, again press the MARK pushbutton, release the control stick, and record the new display in R1 and R3. The data displayed is in the following form:

a. R1= +XXX.XX (Shaft Angle in degrees)
b. R3= +XXX.XX (Time in seconds)

6.2.13.23 Perform the following calculations:

a. Difference between R1 displays = ___.__ (Shaft Angle)
b. Difference between R3 displays = ___.__ (Time)
c. $\frac{\text{Shaft Angle}}{\text{Time}} = \_.\_\_$ deg/sec

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

6.2.13.24 Set the G/N POWER-OPTICS switch on LEB Lighting Control Panel to OFF.

6.2.14 Stabilization Loop Step Response Test.

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding.

6.2.14.2 Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.3 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.

6.2.14.4 Inner Gimbal Response Test.

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.

6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 Enter 0001 into R154. Verify and execute to apply +28 VDC ACE ENABLE to the PSAAM.

6.2.14.4.7 Enter 1000 into R155. Verify and execute to enter a DC step into the 1G stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the settling of the error signal to a value equal to ±5% of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.5 Enter 0000 into R154. Verify and execute to remove +28 VDC ACE ENABLE.

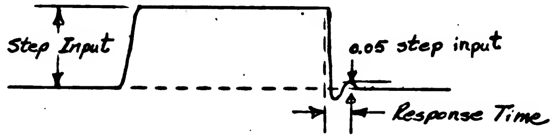


Figure 1. Typical Step Input Response

6.2.15 IRIG Scale Factor Test

6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.

6.2.15.3 Set up the Analog Recorders to monitor the following signals:

a. CG 2117 IG SERVO ERROR
b. CG 2147 MG SERVO ERROR
c. CG 2177 OG SERVO ERROR
d. CG 2120 IG TM CURRENT
e. CG 2150 MG TM CURRENT
f. CG 2180 OG TM CURRENT

6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.

6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton.

6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:

R1 = ±xxxxx (some Nav. Base aximuth)
R2 = ±xxxxx (some test site latitude; see Table I)

6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:

a. To correct R1, on the K-Start enter VERB 21, press ENTER pushbutton, ±xxx.xx, press ENTER (±xxx.xx is correct nav. base azimuth).

b. To correct R2, on the K-Start enter VERB 22, press ENTER pushbutton, ±xx.xxx, press ENTER (obtain correct site latitude from Table I).

Table I

Site	Latitude
NAA	+33.921
MSC	+29.556
KSC	+28.516

6.2.15.8 Verify the correct displays on CRT R1 and R2, then on the K-Start enter VERB 33 and press ENTER pushbutton.

6.2.15.9 VERB 21 NOUN 30 shall flash on the CRT, requesting a load of the test number.

Enter the desired test number from Table II and press the ENTER pushbutton.

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in Table II in the sequence listed. If only one gyro is being tested, the test need only be repeated for the two applicable test numbers.

6.2.15.10 After 160 seconds VERB 06 NOUN 66 shall flash on the CRT. Record the value displayed in R1 for the appropriate Test Number in Table II. The data displayed is the Scale Factor error in parts per million. The Scale Factor error shall not exceed ±1750 PPM.

TABLE II. DISPLAY OF TEST PARAMETERS

Test No.	Symbol	Display in R1
+00001	E - x	±XXXXX
+00002	E - y	±XXXXX
+00003	E + z	±XXXXX
-00001	E + x	±XXXXX
-00002	E + y	±XXXXX
-00003	E - z	±XXXXX

6.2.15.11 Enter VERB 33, ENTER into K148.

6.2.15.12 Repeat 6.2.15.9 through 6.2.15.11 until all test numbers in Table II have been utilized. When the last test number is entered perform only 6.2.15.9 and 6.2.15.10.

6.2.15.13 Enter VERB 34, ENTER into K148.

6.2.15.14 After completion of all test numbers, stop the analog recorders.

6.2.15.15 Enter VERB 40 NOUN 20, ENTER into K148.

6.2.15.16 Enter the following into K148:

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 VERB 06 NOUN 61 shall appear flashing on CRT and will contain the following information:

R1= +xxx.xx (Some NB Azimuth)
R2= +xx.xxx (Some Test Site Latitude)

Insure that R1 = Correct NB Azimuth and R2 = Present Test Site Latitude from Table XX.

6.2.16.7.6 If R1 does not contain the correct NB Azimuth, enter the following sequence into K148.

a. VERB 21, ENTER
b. +xxx.xx, ENTER (where +xxxxx is the NB Azimuth)

6.2.16.7.7 If R2 does not contain present Test Site Latitude enter the following sequence into K148:

a. VERB 22, ENTER

b. Proper Data from Table XX, ENTER

TABLE XX

Location	Latitude
NAA	+33.921
MSC	+29.556
KSC	+28.516

6.2.16.7.8 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.9 VERB 06 NOUN 66 shall appear flashing on CRT. Verify that the following values appear on CRT.

R1 = +00900
R2 = +00000
R3 = +00001

6.2.16.7.10 If the contents of R1 on the CRT are not +00900, enter the following sequence into K148.

a. VERB 21, ENTER

b. +00900, ENTER

6.2.16.7.11 If the contents of R2 on the CRT are not +00000, enter the following sequence into K148:

a. VERB 22, ENTER

b. +00000, ENTER

6.2.16.7.12 If the contents of R3 on the CRT are not +00001, enter the following sequence into K148:

a. VERB 23, ENTER b. +00001, ENTER

6.2.16.7.13 Verify correct display in R1, R2, and R3, Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.16.7.14 After approximately 17 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.

6.2.16.7.15 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.16.7.16 After approximately 90 sec. VERB 06, NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R1 and R2 on the calculation sheet.

6.2.16.7.17 Enter VERB 34 into K148. Press the ENTER pushbutton.

6.2.16.7.18 Repeat steps 6.2.16.7.9 through 6.2.16.7.16, substituting position number +00002 in R3.

6.2.16.7.19 Enter VERB 33 into K148. Press ENTER pushbutton. Record the CRT CDU gimbal angle indication and time.

6.2.16.7.20 After approximately 67 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the CRT CDU gimbal angle indications and time. Record the value on CRT for R2 on the calculation sheet.

6.2.16.7.21 Enter VERB 34, ENTER into K148. Repeat steps 6.2.16.7.9 through 6.2.16.7.17, substituting position number +00003 in R3.

6.2.16.7.22 Repeat steps 6.2.16.7.18 through 6.2.16.7.20, substituting position number +00004 in R3.

6.2.16.7.23 Enter VERB 34 into K148. Press ENTER pushbutton.

6.2.16.7.24 VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

a. R1 = +00900
b. R2 = +00000
c. R3 = +00005

If data is incorrect perform steps 6.2.16.7.10 through 6.2.16.7.12 entering the correct data. Enter VERB 33 into K148. Press ENTER pushbutton.

The PROGRAM ALARM and GIMBAL LOCK status lights shall be illuminated on the DSKY.

6.2.16.7.25 Press the RESET pushbutton. The Program Alarm lamp shall extinguish. In approximately 90 sec, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the data displayed in R1 and R2 on the CRT.

6.2.16.7.26 Enter VERB 34 into K148. Press ENTER pushbutton, Repeat steps 6.2.16.7.24 thru 6.2.16.7.25 substituting position no. +00006.

6.2.16.7.27 Enter VERB 34 into K148. Press the ENTER pushbutton. VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

6.2.16.7.27 (continued)

a. R1 = +00900

b. R2 = +00000

c. R3 = +00007

If the data is incorrect perform steps 6.2.16.7.10 thru 6.2.16.7.12 entering the correct data.

6.2.16.7.28 Enter VERB 33 into K148. Press ENTER pushbutton. The GIMBAL LOCK status lamp shall extinguish. In approximately 17 minutes VERB 06 NOUN 66 shall flash on the CRT. Record the data displayed in R2 of the CRT.

6.2.16.7.29 Repeat steps 6.2.16.7.27 and 6.2.16.7.28 substituting position no. +00008 in R3.

6.2.16.7.30 Repeat steps 6.2.16.7.27 and 6.2.16.7.28 substituting position no. +00009 in R3.

6.2.16.7.31 Repeat steps 6.2.16.7.27 and 6.2.16.7.28 substituting position no. +00010 in R3.

6.2.16.8 To terminate the IMU Performance Test, enter VERB 36 into K148. Press ENTER pushbutton.

6.2.16.9 Enter the following sequence in K148.

a. VERB 40 NOUN 20, ENTER
b. VERB 41 NOUN 20, ENTER
c. +00000, ENTER
d. +00000, ENTER
e. +00000, ENTER

6.2.16.10 Calculations

TABLE XXI

Position No. as Displayed in R3	Quantity Being Measured
+00001	+NBDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDX + ADIAX
+00003	-NBDX +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+Y PIPA G
+00006	-Y PIPA G
+00007	-NBDX + .707 ADSRAX

6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million from the values recorded in 6.2.16.10.1 and record in Table X_1.

a. PIPA S.F. Error = $\left[\frac{2\ \text{local g}}{+\text{PIPAG} - (\text{PIPAG})} - 1.000000\right] 10^6$

b. X PIPA S.F. Error = $\left[\frac{2\ \text{local g}}{\text{line 2} - \text{line 4}} - 1.000000\right] 10^6$

c. Y PIPA S.F. Error = $\left[\frac{2\ \text{local g}}{\text{line 11} - \text{line 12}} - 1.000000\right] 10^6$

d. Z PIPA S.F. Error = $\left[\frac{2\ \text{local g.}}{\text{line 7} - \text{line 9}} - 1.000000\right] 10^6$

The PIPA S.F. Error shall not exceed ±2000 PPM

TABLE XXII Local Gravity values

Location	Local Gravity (cm/sec^2)
NAA	979.56
MSC	979.29
KSC	979.24

6.2.16.10.6 Compute the PIPA Bias in cm/sec^2 from the values recorded in 6.2.16.10.1 and record in Table X_1.

a. PIPA Bias = $\frac{+\text{PIPAG} + (-\text{PIPAG})}{2}$

b. X PIPA Bias = $\frac{\text{line 2} + \text{line 4}}{2}$

c. Y PIPA Bias = $\frac{\text{line 11} + \text{line 12}}{2}$

d. Z PIPA Bias = $\frac{\text{line 7} - \text{line 9}}{2}$

The PIPA Bias shall not exceed ±2.28 cm/sec^2.

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA from the values recorded in 6.2.16.10.1 and record in Table X_1.

a. NBDX = - (line 6) =
NBDX = - (line 1 =
NBDZ = line 3 =
NBD shall not exceed ± 15 meru.

6.2.17 SXT-NB-Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification Fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The G&N shall have had OPERATE power applied for a minimum of 1 hour.

6.2.17.3 Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 ± 3.0 VDC. Verify that the OPTX 28V 800 cps 1% 0° ph (CG 1211) and OPTX 28V 800 cps 5% -90° ph (CG 1212) are not flashing on the CRT.

6.2.17.4 Enter the following into K148.

a. VERB 01 NOUN 10, ENTER
b. 00003, ENTER
c
Record R1 = AAAAA and the time of day.

6.2.17.5 Enter the following into K148.

a. VERB 21 NOUN 02, ENTER
b. 01300, ENTER
c. AAAAA, ENTER
d. VERB 06 NOUN 02, ENTER
e. 01300, ENTER

Record R1 = BBBBB

6.2.17.6 Perform the following calculations:

a. $\frac{\text{R1 (BBBBB)} \times 5.12}{3600}$ = CCCC.C (Hrs. in high order scaler channel 3)

b. 23.3 - CCCC.C = DDDDD Hrs.

c. Add DDDDD to time of day recorded in step 1.

DO NOT enter any of the SM misalignment tests within -0.2 hours of the time of day calculated in step 6.2.17.6.c. This is the time at which the high order scaler, channel 3, will overflow. If a SM misalignment test is being performed at this time, unacceptable test results will occur.

6.2.17.7 On the G&N Indicator Control Panel set the following switches to the position indicated.

a. TELESCOPE TRUNNION to SLAVE to SXT
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to LO
d. OPTICS MODE to ZERO

6.2.17.8 Enter the following into the DSKY:

a. VERB 01 NOUN 01, ENTER
b. 00362, ENTER

Record R1 = XXXXY

6.2.17.9 Enter the following into the DSKY:

a. VERB 21 NOUN 01, ENTER
b. 00362, ENTER
c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded above.

TABLE II

Y (from 6.2.17.8)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.17.10 Initiate the test by entering the following sequence into the LEB DSKY.

a. VERB 57, ENTER
b. 00003, ENTER

6.2.17.11 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

a. R1 = +13500
b. R2 = +xx.xxx (Site Latitude from Table I)

Table 1

Test Site	Latitude
NAA	+33.921
KSC	+28.516
MSC	+29.556

6.2.17.12 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

a. VERB 21, ENTER
b. +13500, ENTER
c. VERB 22, ENTER
d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
e. VERB 33, ENTER

6.2.17.13 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

a. +00001, ENTER (Position Number)
b. +00000, ENTER
c. +00001, ENTER

6.2.17.14 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

a. R1 = +xxx.xx (Y_{NB} Azimuth)
b. R2 = ±xx.xxx (Y_{NB} Elevation)
c. R3 = $\overline{0}0001$

6.2.17.15 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.

a. VERB 24, ENTER
b. +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} Azimuth)
c. +xx.xxx ± 02.000 degrees, ENTER (Y_{NB} Elevation)
d. VERB 33, ENTER

6.2.17.16 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

a. R1 = +xxx.xx (Z_{NB} Azimuth)
b. R2 = ±xx.xxx (Z_{NB} Elevation)
c. R3 = $\overline{0}0002$

6.2.17.17 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.

a. VERB 24, ENTER
b. +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
c. +xx.xxx ± 02.000 degrees, ENTER (Z_{NB} Elevation)
d. VERB 33, ENTER

6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.

6.2.17.25 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.

6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.

NOTE: The following two MARKS must be performed as quickly as possible. In no case shall the time between the first and second MARK exceed two minutes.

6.2.17.27 Repeat steps 6.2.17.23 through 6.2.17.26.

6.2.17.28 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).

6.2.17.29 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table III for PIPA displayed). Record R1 and R2.

6.2.17.30 Enter VERB 34 ENTER into the DSKY to terminate the test.

6.2.17.31 Repeat steps 6.2.17.10 through 6.2.17.30 substituting position no. 00002 in 6.2.17.13.a.

6.2.17.32 Enter the following sequence into the DSKY:

a. VERB 36, ENTER
b. VERB 41 NOUN 20, ENTER
c. +00000, ENTER
d. +00000, ENTER
e. +00000, ENTER

6.2.17.33 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Table III. DISPLAY CONDITIONS AT TEST COMPLETION

Position	SM Orientation			Horizontal Misalignment Component	
	X_{SM}	Y_{SM}	Z_{SM}	6.2.17.28	6.2.17.29
1.	UP	SW	SE	Y_{SM}	Z_{SM}
2.	SE	SW	DN	X_{SM}	Y_{SM}
3.*	SE	UP	SW	X_{SM}	Z_{SM}

*Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.34 Calculations

6.2.17.34.1
a. Y_{SM} misalignment = (   ) R1, R2
b. Z_{SM} misalignment = (   ) R1, R2
c. X_{SM} misalignment = (   ) R1, R2
d. Y_{SM} misalignment = (   ) R1, R2

6.2.17.34.2 Enter the latest values from 6.2.16 IMU Performance Test.

a. X PIPA bias = ____________________ cm/sec^2
b. Y PIPA bias = ____________________ cm/sec^2
c. Z PIPA bias = ____________________ cm/sec^2
d. θ_x = 210 (X PIPA bias) = ____________________ arc sec.
e. θ_y = 210 (Y PIPA bias) = ____________________ arc sec.
f. θ_z = 210 (Z PIPA bias) = ____________________ arc sec.

6.2.17.34.3
a. Y_{SM} misalignment...
b. Z_{SM} misalignment...
c. X_{SM} misalignment...
d. Y_{SM} misalignment...

The SM misalignments in each orientation, excluding PIPA bias, shall not exceed ±150 arc seconds.

6.2.18 Gyrocompassing Test

Note: Perform Master Initialization 6.2.5.3 before proceeding.

6.2.18.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that 28 vdc OPTICS OPERATE BUS (CG 1530) is +28.0 ± 3.0 vdc. Verify that OPTX 28V 800 cps 1% 0° (CG 1211) and OPTX 28V 800 cps 5% - 90° (CG 1212) are not flashing on the CRT.

6.2.18.2 Obtain the most recent values for NBD, ADSRA, and ADIA. Load this data into the CMC using the following sequence:

VERB 21 NOUN 01, ENTER
1432, ENTER
NBDX, ENTER
1433, ENTER
NBDY, ENTER
1434, ENTER
NBDZ, ENTER
1435, ENTER
ADIAX, ENTER
1436, ENTER
ADIAY, ENTER
1437, ENTER
ADIAZ, ENTER
1440, ENTER
ADSRAX, ENTER
1441, ENTER
ADSRAY, ENTER
1442, ENTER
ADSRAZ, ENTER

6.2.18.3 If the gyrocompass azimuth will require that the Stable Member be aligned to a non-standard position, it will be necessary to load the correct orientation matrix into the CMC. This matrix loaded into PRELMTRX through PRELMTRX + 17D.

6.2.18.4 Enter the following into the DSKY:

a. VERB01 NOUN 01, ENTER
b. 00362, ENTER

Record R1 = XXXXY

6.2.18.5 Enter the following into the DSKY:

a. VERB 01 NOUN 01, ENTER
b. 00362, ENTER
c. XXXXY^1, ENTER where Y' is determined by Table I and XXXX is that recorded in 6.2.18.4.

TABLE I

Y (From 6.2.18.4)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.6 Enter the following into the DSKY:

a. VERB 57, ENTER
b. 00007, ENTER

6.2.18.7 Observe the following on the DSKY.

a. VERB 06 NOUN 61 flashing
b. R1 - ± XXX.XX (Some Z NB azimuth)
c. R2 = ∓ XX.XXX (Some Test Site Latitude)

If the displays are correct, proceed to step 6.2.18. If not perform 6.2.18.8

6.2.18.8 Enter the following into the DSKY:

a. To change R1 enter VERB 21, ENTER ± XXX.XX, ENTER where ± XXX.XX is the correct Z NB azimuth
b. To change R2 enter VERB 22, ENTER; + XX.XXX, ENTER where + XX.XXX is the correct Site Latitude from Table II.

TABLE II

Location	Latitude
NAA	33.921
KSC	28.516
MSC	29.556

6.2.18.9 Enter VERB 33, ENTER into the DSKY

6.2.18.10 Observe the following displayed on the DSKY

a. VERB 06 NOUN 66 flashing
b. R1 = XXXXX (1/5 vertical erect time in sec)
c. R3 = XXXXX (Position No.)

6.2.19 **CMC Voltage Margin Test**

6.2.19.1 Verify that the G&N IMU HTR MNA & MNB circuit breakers are engaged, Computer MNA & MNB breakers are engaged, IMU MNA & MNB circuit breakers are not engaged, and the G&N Power - IMU switch on the LEB Lighting Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020). The DSKY alpha numerics and status lamps shall be turned to the absolute minimum brightness for this test.

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX. X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3 Into R154 insert 0001. Verify and execute.

6.2.19.4 Into C156 insert -040001244. Verify and execute. Verify on the CRT that GV0116 is between -3.0 and -5.0 VDC.

6.2.19.5 Into C156 insert -050001234. Verify and execute. Verify on the CRT that GV0106 is between -4.0 and -6.0 VDC.

6.2.19.6 Into R154 insert 0111. Verify and execute.

6.2.19.7 Observe CG 1020, +14 VDC CMC Power Supply, and CG 1030, +4 VDC CMC Power Supply, on the CRT. Repeat 6.2.19.3 through 6.2.19.6 adjusting each C-Start entry until CG 1020 is +12.1 (+0.1, -0.0) VDC and CG 1030 is +3.40 (+0.03 - 0.00) VDC.

6.2.19.8 Initiate CMC Self Check by inserting the following into K148:

a. ERROR RESET
b. VERB 21 NOUN 27, ENTER
c. 77777, ENTER
Wait 200 seconds.

6.2.19.9 Insure that the DSKY RESTART lamp does not light, and that

a. VERB 05 NOUN 31
b. R1 = 01102
does not appear on the DSKY.

6.2.19.10 Set the INHIBIT VOLTAGE FAIL switch on the PSAAM to OFF. Verify the RESTART lamp on the DSKY is lighted. Disregard other DSKY indications. If RESTART does not light, repeat 6.2.19.3.

6.2.19.11 Set the INHIBIT VOLTAGE FAIL switch to ON. Insert the following into K148:

a. ERROR RESET
b. VERB 21 NOUN 27, ENTER
c. 77777, ENTER

6.2.19.12 Into R154 insert 0001. Verify and execute.

6.2.19.13 Into C156 insert +108001244. Verify and execute. Verify on the CRT that GV0116 is between +0.8 and +11.8 VDC.

6.2.19.14 Into R154 insert 0111. Verify and execute.

6.2.19.15 Observe CG 1020, +14 VDC CMC Power Supply on the CRT. Repeat 6.2.19.12 through 6.2.19.14 adjusting the C-Start entry until CG 1020 is 16.4 (+0.0, −0.1) VDC.

6.2.19.16 Press ERROR RESET on K148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and that

a. VERB 05 NOUN 31
b. R1 = 01102
does not appear on the DSKY.

6.2.19.17 Set the INHIBIT VOLTAGE FAIL switch on the PSAAM to OFF. Verify that the DSKY RESTART lamp is lighted. Disregard other DSKY indications.

6.2.19.18 Set the INHIBIT VOLTAGE FAIL switch on the PSAAM to ON. Into K148 insert

a. ERROR RESET
b. VERB 21 NOUN 27, ENTER
c. 77777, ENTER

6.2.19.19 Into R154 insert 0001. Verify and execute.

6.2.19.20 Into C156 enter +092001234. Verify and execute. Verify on the CRT that GV0106 is between +8.2 and +10.2 VDC.

6.2.19.21 Into R156 insert 0111. Verify and execute.

6.2.19.22 Observe CG 1030, +4 VDC CMC Power Supply on the CRT. Repeat 6.2.19.19 through 6.2.19.21 adjusting the C-Start entry until CG 1030 is +4.60 (+0.00, −0.03) VDC.

6.2.19.23 Press ERROR RESET on K148. Wait 200 seconds. Ensure that the DSKY RESTART does not light and

a. VERB 05 NOUN 31
b. R1 = 01102
does not appear on the DSKY.

6.2.19.24 Set the INHIBIT VOLTAGE FAIL switch on the PSAAM to OFF. Verify that the DSKY RESTART lamp is lighted.

6.2.19.25 Set the INHIBIT VOLTAGE FAIL switch on the PSAAM to ON. Into K148 insert

a. ERROR RESET
b. VERB 21 NOUN 27, ENTER
c. 77777, ENTER

6.2.19.26 Into R154 insert 0001. Verify and execute.

6.2.19.27 Into C156 insert -040001244. Verify and execute. Verify on the CRT that GV0116 is between -3.0 and -5.0 VDC.

6.2.19.28 Into R154 insert 0111. Verify and execute.

6.2.19.29 Observe CG 1020, +14 VDC CMC Power Supply on the CRT. Repeat 6.2.19.26 through 6.2.19.28 adjusting the C-Start entry until CG 1020 is +12.1 (+0.1, -0.0) VDC.

6.2.19.30 Press ERROR RESET on K148. Wait 200 seconds. Ensure that the DSKY RESTART lamp does not light and

a. VERB 05 NOUN 31
b. R1 = 01102
does not appear on the DSKY.

6.2.19.31 Set the INHIBIT VOLTAGE FAIL switch on the PSAAM to OFF. Verify that the DSKY RESTART lamp is lighted. Disregard other DSKY indications.

6.2.19.32 Into R154 insert 0000. Verify and execute.

6.2.19.33 Terminate CMC Self-Check by inserting into K148.

a. ERROR RESET
b. VERB 21, NOUN 27, ENTER
c. 00000, ENTER

6.2.19.34 Ensure that CG 1020, +14 VDC CMC Power Supply indication, is +14.0±0.4 and that CG 1030, +4 VDC CMC Power Supply indication is +4.00±0.20 VDC on the CRT.

NUMBER	REVISION LETTER	PAGE

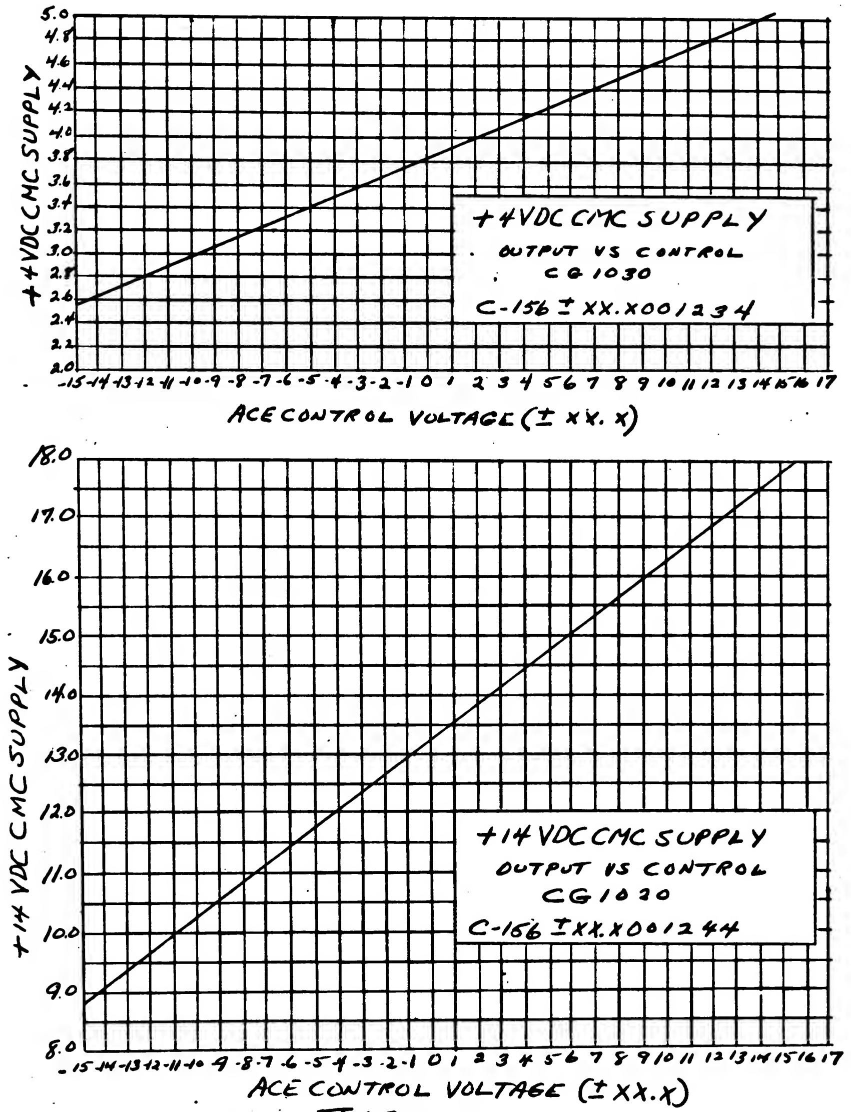


TABLE I

6.2.21 Spacecraft Control and Displays Test.

6.2.21.1 Proceed with this test if the Operate Power On Test of 6.2.3 and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding.

6.2.21.2 FDAI Attitude Error.

6.2.21.2.1 Insert in K148

a. V57 ENTER
b. 00013 ENTER

6.2.21.2.2 Observe on CRT

a. V06 N01 Flashing
b. PROG 07
c. NO ATT ON
d. R1, R2, and R3 Approx. 00000

6.2.21.2.3 Insert in K148

a. VERB 33, ENTER

6.2.21.2.4 Observe on CRT

a. V06 R1 Flashing
b. R1 +00385
c. R2 -00385
d. R3 +00385
e. NO ATT OFF

6.2.21.2.5 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees

6.2.21.2.6 Insert in K148

a. VERB 33, ENTER

6.2.21.2.7 Observe on CRT

a. V06 N01 Flashing
b. R1 +00384
c. R2 -00384
d. R3 +00384

6.2.21.2.8 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees

6.2.21.2.9 Insert in K148

a. VERB 33, ENTER

6.2.21.2.10 Observe on CRT

a. V06 N01 Flashing
b, R1 +00160
c. R2 -00160
d. R3 +00160

6.2.21.2.11 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +6.95 ± 0.69 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -6.95 ± 0.69 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +6.95 ± 0.69 degrees

6.2.21.2.12 Insert in K148

a. VERB 33, ENTER

6.2.21.2.13 Observe on CRT

a. V06 N01 Flashing
b. R1 +00135
c. R2 -00135
d. R3 +00135

6.2.21.2.14 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +5.88 ± 0.59 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -5.88 ± 0.59 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +5.88 ± 0.59 degrees

6.2.21.2.15 Insert in K148

a. VERB 33, ENTER

6.2.21.2.16 Observe on CRT

a. V06 N01 Flashing
b. R1 +00090
c. R2 -00090
d. R3 +00090

6.2.21.2.17 Record CRT indications.

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +3.93 ± 0.39 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -3.93 ± 0.39 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +3.93 ± 0.39 degrees

6.2.21.2.18 Insert in K148

a. VERB 33, ENTER

6.2.21.2.19 Observe on CRT

a. V06 N01 Flashing
b. R1 +00000
c. R2 +00000
d. R3 -00090

6.2.21.2.20 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT 0.00 ± 0.19 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT 0.00 ± 0.19 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT -3.93 ± 0.39 degrees

6.2.21.2.21 Insert in K148

a. VERB 33, ENTER

6.2.21.2.22 Observe on CRT

a. V06 N01 Flashing
b. R1 -00090
c. R2 +00090
d. R3 -00135

6.2.21.2.23 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -3.93 ± 0.39 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +3.93 ± 0.39 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT -5.88 ± 0.59 degrees

6.2.21.2.24 Insert in K148

a. VERB 33, ENTER

6.2.21.2.25 Observe on CRT

a. V06 N01 Flashing
b. R1 -00135
c. R2 +00135
d. R3 -00160

6.2.21.2.26 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -5.88 ± 0.59 degrees
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +5.88 ± 0.59 degrees
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT -6.95 ± 0.69 degrees

6.2.21.2.27 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.28 Observe on CRT

- a. V06 N01 Flashing
- b. R1 -00160
- c. R2 +00160
- d. R3 -00384

6.2.21.2.29 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -6.95 ± 0.69 degrees
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +6.95 ± 0.69 degrees
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees

6.2.21.2.30 Insert K148

- a. VERB 33, ENTER

6.2.21.2.31 Observe on CRT

- a. V06 N01 Flashing
- b. R1 -00384
- c. R2 +00384
- d. R3 -00385

6.2.21.2.32 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees

6.2.21.2.33 Insert in K148

- a. VERB 33, ENTER

6.2.21.2.34 Observe on CRT

- a. V06 N01 Flashing
- b. R1 -00385
- c. R2 +00385
- d. R3 +00000

6.2.21.2.35 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	-16.88 ± 1.65 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	+16.88 ± 1.65 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	0.00 ± 0.19 degrees

6.2.21.2.36 Insert in K148

a.	V21 N01	ENTER
b.	02545	ENTER
c.	03302	ENTER
d.	V33	ENTER

6.2.21.2.37 Observe on CRT

a.	V06 N03	Flashing
b.	NO ATT	ON
c.	R1	+00000 approximately
d.	R2	+00000 approximately
e.	R3	+00000 approximately

6.2.21.3 TVC Test

6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N Interface.

6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control Panel to MAN.

6.2.21.3.3 Insert in K148
- a. VERB 33, ENTER

6.2.21.3.4 Observe on CRT
- a. V 01 N10 Flashing
- b. R1 X7373
- c. R3 00030

6.2.21.3.5 Insert in K148
- a. V 33 ENTER

6.2.21.3.6 Observe on CRT
- a. V 01 Noun 10 Flashing
- b. R1 37777
- c. R3 00031

6.2.21.3.7 Insert in K148
- a. V 33 ENTER

6.2.21.3.8 Observe on CRT
- a. V06 N03 Flashing
- b. R1 +00385
- c. R2 -00385
- d. R3 +00003

6.2.21.3.9 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT +16.88 ± 1.00 degrees
- b. CG 3721 SHAFT CDU DAC OUTPUT -16.88 ± 1.00 degrees

6.2.21.3.10 Insert in K148
- a. VERB 33, ENTER

6.2.21.3.11 Observe on CRT
- a. V06 N 03 Flashing
- b. R1 +00384
- c. R2 -00384
- d. R3 +00003
- e. NO ATT OFF

6.2.21.3.12 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT +16.88 ± 1.00 degrees
- b. CG 3721 SHAFT CDU DAC OUTPUT -16.88 ± 1.00 degrees

6.2.21.3.13 Insert in K148
- a. VERB 33, ENTER

6.2.21.3.14 Observe on CRT
- a. V06 N 03 Flashing
- b. R1 +00160
- c. R2 -00160
- d. R3 +00003

6.2.21.3.15 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT +6.95 ± 0.41 degrees
- b. CG 3721 SHAFT CDU DAC OUTPUT -6.95 ± 0.41 degrees

6.2.21.3.16 Insert in K148
- a. VERB 33 ENTER

6.2.21.3.17 Observe on CRT
- a. V06 N 03 Flashing
- b. R1 +00135
- c. R2 -00135
- d. R3 +00003

6.2.21.3.18 Record CRT indications
- a. CG 3722 TRUNNION CDU DAC OUTPUT +5.88 ± 0.35 degrees
- b. CG 3721 SHAFT CDU DAC OUTPUT -5.88 ± 0.35 degrees

6.2.21.3.19 Insert in K148
- a. VERB 33 ENTER

6.2.21.3.20 Observe on CRT

a. V06 N 03 Flashing
b. R1 +00090
c. R2 -00090
d. R3 +00003

6.2.21.3.21 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +3.93 ± 0.24 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT -3.93 ± 0.24 degrees

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.2.23 Insert in K148

a. VERB 33 ENTER

6.2.21.3.24 Observe on CRT

a. V06 N 03 Flashing
b. R1 +00000
c. R2 +00000
d. R3 +00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a. CG 3722 TRUNNION CDU DAC OUTPUT 0.00 ± 0.19 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT 0.00 ± 0.19 degrees

6.2.21.3.26 Insert in K148

a. VERB 33 ENTER

6.2.21.3.27 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00090
d. R2 +00090
d. R3 +00003

6.2.21.3.28 Record CRT indidations

a. CG 3722 TRUNNION CDU DAC OUTPUT -3.93 ± .24 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +3.93 ± .24 degrees

6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. VERB 33 ENTER

6.2.21.3.31 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00135
c. R2 +00135
d. R3 +00003

6.2.21.3.32 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -5.88 ± 0.35 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +5.88 ± 0.35 degrees

6.2.21.3.33 Insert in K148

a. VERB 33 ENTER

6.2.21.3.34 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00160
c. R2 +00160
d. R3 +00003

6.2.21.3.35 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -6.95 ± 0.41 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +6.95 ± 0.41 degrees

6.2.21.3.36 Insert in K148

a. VERB 33 ENTER

6.2.21.3.37 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00384
c. R2 +00384
d. R3 +00003

6.2.21.3.38 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -16.88 ± 1.00 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +16.88 ± 1.00 degrees

6.2.21.3.39 Insert in K148

a. VERB 33 ENTER

6.2.21.3.40 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00385
c. R2 +00385
d. R3 +00003

6.2.21.3.41 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -16.88 ± 1.00 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +16.88 ± 1.00 degrees

6.2.21.3.42 Insert in K148

a. V 34 ENTER
b. V 40 N 20 ENTER
c. V 41 N 20 ENTER
d. +00000 ENTER
e. +00000 ENTER
f. +00000 ENTER

APPENDIX I

Signal	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	+120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2.5 VDC TM BIAS	+2.50 ± 0.05 VDC	0%
CG 1201	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	IMU 28V .8KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	IMU 28V .8KC 0°RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	OPTX 28V .8KC 5% - 90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	PH DIFF OPTX 1% IMU 1%	0° ± 10°	3%
CG 1331	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	+28 VDC IMU OPERATE BUS	28.8 ± 3 VDC	0%
CG 1510	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	X PIPA SG O/P	5 VRMS max	3%
CG 2021	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	IG 1X RESOLVER O/P SIN	(18.38 ± 1.84) 19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2113	IG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2117	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	2%
CG 2138	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	MG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	MG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%
CG 2168	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	OG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	OG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	OG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS @ null	2%
CG 2180	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%

Signal	Nomenclature	G&N Test Requirements	PSAAM and/or SCA Uncertainty % of Full Scale
CG 2219	PITCH ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	IG CDU FINE ERROR	0.0 ± 0.7 VRMS @ null	1%
CG 2221	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @ null	1%
CG 2249	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2250	MG CDU FINE ERROR	0.0 ± 0.7 VRMS @ null	1%
CG 2251	MG CDU COARSE ERROR	0.0 ± 0.68 VRMS @ null	1%
CG 2279	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2280	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	0%
CG 3011	TRUNNION CDU FINE ERROR	0.0 ± 0.07 VRMS @ null	1%
CG 3021	SHAFT CDU FINE ERROR	0.0 ± 0.07 VRMS @ null	1%
CG 3117	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	SXT TRUNNION SERVO ERROR IN PHASE	2 VRMS max	2%
CG 3140	SXT SHAFT TACH O/P	3.1 ± 1.1 VRMS @Hi Rate	2%
CG 3145	SXT SHAFT MTR CONTROL WINDING	3.3 ± 1.3 VRMS @Hi Rate	2%
CG 3150	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	SXT TRUNNION MTR CONTROL WINDING	0.85 ± 0.35 VRMS at Hi Rate	2%
CG 3160	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	SCT TRUNNION TACH O/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	SHAFT CDU DAC O/P	5.06 ± 0.50VRMS @17°	1%
CG 3722	TRUNNION CDU DAC O/P	5.06 ± 0.50 VRMS @17°	1%
CG 4300	CMC TEMP	87.5 ± 42.5°F	0%
YG 6020	PIPA CAL MODULE TEMP	72.5 ± 27.5°F	0%
CG 6021	IMU 800 cps 5% TEMP (PSA)	90 ± 30°F	0%
CG 2301	IRIG TEMPERATURE	135 ± 2.5°F in Operate	0%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.

APOLLO G&N Specification
ND 1002348 B
Original Issue Date: 17 FEB 67
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Class A Release

POST INSTALLATION CHECKOUT PROCESS SPECIFICATION FOR THE APOLLO GUIDANCE & NAVIGATION SYSTEM BLOCK II-KSC

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised	Approvals
5/11/67	A	33750	10-12, 15, 24, 35-46, 51-56, 58-67, 73-78, 81,	
			82, 84-86, 91, 95-97, 99-102, 105-119. Was	
			119 pages, now 120.	EA
9/29/67	B	34782	2-128; Specification was 128 pages, now 129	EA

This specification consists of page 1 to 129 inclusive.

APPROVALS	NASA/MSC	2/17/67		AC

NUMBER	REVISION LETTER								PAGE

1. INTRODUCTION

1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one of each of the following major assemblies: The applicable part numbers shall be determined by drawing No. 2014999.

1 - Optical Unit Assembly
1 - Navigation Base Assembly, Block II
1 - Inertial Measurement Unit (IMU) & PIPA Elect. Assy.
1 - Power and Servo Assembly (PSA)
1 - Apollo Guidance Computer Group
1 - G&N Interconnect Harness Assembly
1 - Signal Conditioner Assembly
1 - Display and Control Group (D & C)
1 - Coupling Data Unit

1.2 The G&N System herein shall be identified as a Block II system. The computer contains the program flight ropes in the core rope memory. The test requirements herein are based on Sundisk Rev. 202.

2. SCOPE

2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module Spacecrafts and tested in the VAB or on the PAD.

2.2 This document is to be used as technical support for all Block II G&N System test documentation for Command Module spacecraft testing. This document shall be amended by addendum to support applicable hardware, mission or program differences.

3. APPLICABLE DOCUMENT

3.1 Documents Required by this Specification

3.1.1 When the requirements of this specification conflict with the drawing requirements, the drawing requirements shall have precedence.

PS 2015000	Master End Item Specification, Part II, Product Configuration and Acceptance Test Requirements, G&N Spacecraft Equipment Command Module, Block II
ICD MH01-01307-216	CDU to TVC Servo Amps Electrical Block II
ICD MH01-01324-216	Attitude Error Signals Electrical Block II
ICD MH 01-01325-216	Total Attitude Signals
ICD MH01-01327-216	G&N Electrical Input Power
ICD MH01-01328-216	G&N Data Transmission to Operational and Flight Qual. Telemetry
ICB MH01-01342-216	G&N System Caution and Warning System Interface
ICD MH01-01349-416	G&N Thermal Requirements for Block II AGE
ICD MH01-01344-216	Mode Control Signals S/C to ISS Discretes
ICD MH01-01335-200	Electrical Inertial Temperature Controller
ICD MH01-01380-216	Command Module Guidance Computer Electrical Interfaces Block II
ICD MH01-01386-216	Attitude Error to SIVB
MH01-01390-200	G&N PSA Adapter Module ACE-S/C DTMS and DTCS Block II Vehicles.
MA0201	ACE-S/C Computer Subprogram Program Requirements S/C 101 KSC
MA0308-0107	Mechanical Installation Specification for Apollo Guidance Equipment
MA0610-018A	Contamination Control-Apollo Command Module and Service Module
SID 65-1642	Apollo Command Module/Service Module Measurement Requirements for Block II

3.1.2 The following addendums are applicable to this document.

a. Addendum I, MSO Testing

4.0 MATERIAL AND EQUIPMENT

4.1 The following test equipment shall be used to perform the requirements of this specification. If protection to personnel and equipment is not decreased, items, except government furnished parts, equivalent to those listed may be used.

ITEM	QUANTITY	DESCRIPTION
1	1	Digital Test Measurement System Model No. C14-208
2	1	Digital Test Command System, Model No. C14-207
3	1	Data Interleaver System, Model No. C14-232
4	1	External Digital Test Command Unit Model No. C14-231
5	1	S/C Ground Power Supply Model No. C14-418
6	1	Breakout Box, Test, CM-SM Adapter Model No. C14-467
7	1	Electrical Cable Set Model No. C34-391.
8	1	ICTC 513-100 MODEL 513-100 (MSO only)
9	1	PSA Adapter Module, Model No. A23-304
10	1	OPTICS SUPPORTING FIXTURE MODEL A14-135 (MSO only)
11	1	G&N INSTALLATION QUALIFICATION FIXTURE MODEL NO. A23-097 (MSO only)
12	1	Theodolite (DKM 3 or equivalent) Model No. A23-079).
13	1	Retroflecting Prism, Model No. A23-200
14	1	Portable Light Assembly Model No. A23-196
15	1	Vacuum Tube Volt Ohmmeter (VTVOM)
16	1	Calculator (Friden or equivalent)
17	1	Movable Optics Target
18	1	SCT Resolution Check Card
19	1	Electrical Cable Portable G&N System, Model No. C14-462
20	1	Electronic Counter with Preset Counter (Hewlett Packard 5245L with 526A Preset Plug-In Unit, or equivalent).
21	1	Cable Set, SMD9-17166

ITEM	QUANTITY	DESCRIPTION
22	1	Cable Set SMD9-17167
23	1	Test Box, SMD9-17003
24		PORTABLE TEMPERATURE CONTROLLER MODEL NO. S23-011 (VAB & PAD ONLY)
25		WHEATSTONE BRIDGE

5.0 GENERAL REQUIREMENTS

5.1 Safety Requirements

5.1.1 Operator Safety

5.1.1.1 Normal Safety precautions shall be observed throughout the G&N post-installation checkout.

5.1.2 Equipment Safety

5.1.2.1 To preserve the operational life of the components of the G&N Hardware under test, settings and adjustments shall be performed only when specified in the test procedure. Care shall be exercised in the accomplishment of all settings and adjustments to avoid excessive wear or damage to the equipment. All precautionary measures stated throughout the test procedures shall be strictly adhered to.

5.1.2.2 In no event shall the Inertial Components Temperature Controller (ICTC) be disconnected from connector 45J2 of the PSA except when specified to do so in a specific test.

5.1.2.3 The generation of noise alarm indication, as evidenced by one or more Noise Peak Event lights becoming lighted, shall be cause for immediate determination of effects on the G&N System Test in progress. In the event of detrimental effects on the system test, trouble shooting procedures shall be initiated to determine the cause of the alarm. Testing shall continue only after demonstrating that the cause of the noise alarm has been located and that remedial action has been or will be taken, or that the transient or noise causing the alarm has no detrimental effect on the G&N System or test in progress.

5.1.2.4 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as nonconforming. The normal test sequence may be continued on determination of the cause of the nonconformance if not detrimental to the G&N System or other interfacing subsystems. This determination shall have the concurrence of the G&N contractor test team. All nonconformance shall be investigated and cleared by waiver, (FNN), correction of test specification, or hardware replacement. The suspected malfunctioning hardware shall be removed and returned to the laboratory, where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable unit be installed in the G&N System.

5.1.2.5 The G&N System shall be operating in STANDBY mode with CMC power applied for a minimum of two hours prior to torquing of inertial components. In the event STANDBY or CMC power is interrupted, an equivalent time period shall be allowed when power is restored before transfer to the OPERATE mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory. Exceptions to the above are noted in 6.2.5.2.

5.1.2.6 The interruption of +28 VDC power to the G&N System through the Main A and Main B power busses shall be cause for the Command Module G&N System operator to immediately initiate the Emergency shutdown procedure (6.1.4) to preclude damage to the G&N System.

5.1.2.7 The SCT and SXT eyepieces shall be stowed whenever the instruments are not in use to preclude damage to them. It shall be necessary to install the eyepieces when testing requires use of the instrument.

5.1.2.8 To preserve the operational life of the components of the MDC and LEB DSKY's, the monitor routines shall be used only when required by test procedure or trouble shooting. Such routines shall be terminated as quickly as possible in the test flow. Computer routines which cause the DSKY display to flash (either requesting data or displaying data) shall also be terminated as quickly as possible.

5.1.2.9 To reduce the possibility of the Optics drifting into the stops the Optics Speed switch should be set to LO whenever the optics is to be on and not used for any appreciable time.

5.1.2.10 Avoid repeated slewing of SXT Shaft and Trunnion into the mechanical stops.

5.2 Standard Environmental Conditions

5.2.1 The G&N System when installed in the Command Module shall be tested in an environment in accordance with ICD MH01-1348-416. At no time shall the dust particle count exceed Level 3000,000 of Federal Standard 209 with no more than 2,000 particles per cubic foot larger than 5 microns; no more than 35 particles larger than 65 microns with no more than 3 of these 35 larger than 100 microns in existence. Dust covers shall be installed on the SXT and SCT per KD MH01-01350-116 when optics are not under test.

5.2.1.1 For periods of G&N Testing with the optical heads and the eyepieces of the SCT and SXT of the C/M G&N uncovered, or with the eyepieces removed, the environment shall meet at least the Class 100,000 particle size and count.

5.2.1.2 With the optical heads covered and the eyepieces installed or covered on the optical components (SXT, SCT), the ambient environment shall meet the following conditions for particle size and count. No more than 1,400 particles 5.0 microns or larger per cubic foot.

5.2.2 The APOLLO G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD MH01-01349-416.

5.3 Test Equipment Tolerances

5.3.1 Measurements and tolerances are specifications stated herein are basic G&N System performance specifications. Calibration data must be supplied to the Acceptance Checkout Equipment (ACE) for the Power and Servo Assembly Adapter Module (PSAAM) and Signal Conditioner Assembly (SCA) performance. Final tolerances must include PSAAM and Signal Conditioner stability uncertainties (see appendix 1) as well as ACE and ACE carry-on conditioning uncertainties.

5.4 Test Sequence

5.4.1 The test sequence should follow the flow chart of Figure 1, except for 6.2.5, Turn-On and Turn-Off procedure, which may be performed as the requirement arises.

TABLE I

Paragraph No.	Test Title
6.2.1	Application of Standby Power to G&N System
6.2.2	CMC Operational Test
6.2.3	Operate Power On Test
6.2.4	G&N Power Supplies Test
6.2.5	General Turn Off and Turn On Procedures
6.2.6	G&N Operational Test
6.2.7	Gimbal Friction Test
6.2.8	G&N Panel Brightness & Lamp Test
6.2.9	Semi-Automatic Mode Control Test
6.2.10	Zero Optics Test
6.2.11	Optics Coordinate Transformation Control Test
6.2.12	Optics Function Test - VAB and PAD
6.2.13	Optics Slew Rate Test
6.2.14	Stabilization Loop Step Response Test
6.2.15	IRIG Scale Factor Test
6.2.16	IMU Performance Test
6.2.17	Fine Alignment Test SXT-NB-IMU
6.2.18	Gyrocompassing Test
6.2.19	Voltage Margin Test
6.2.20	S/C Control & Display Test

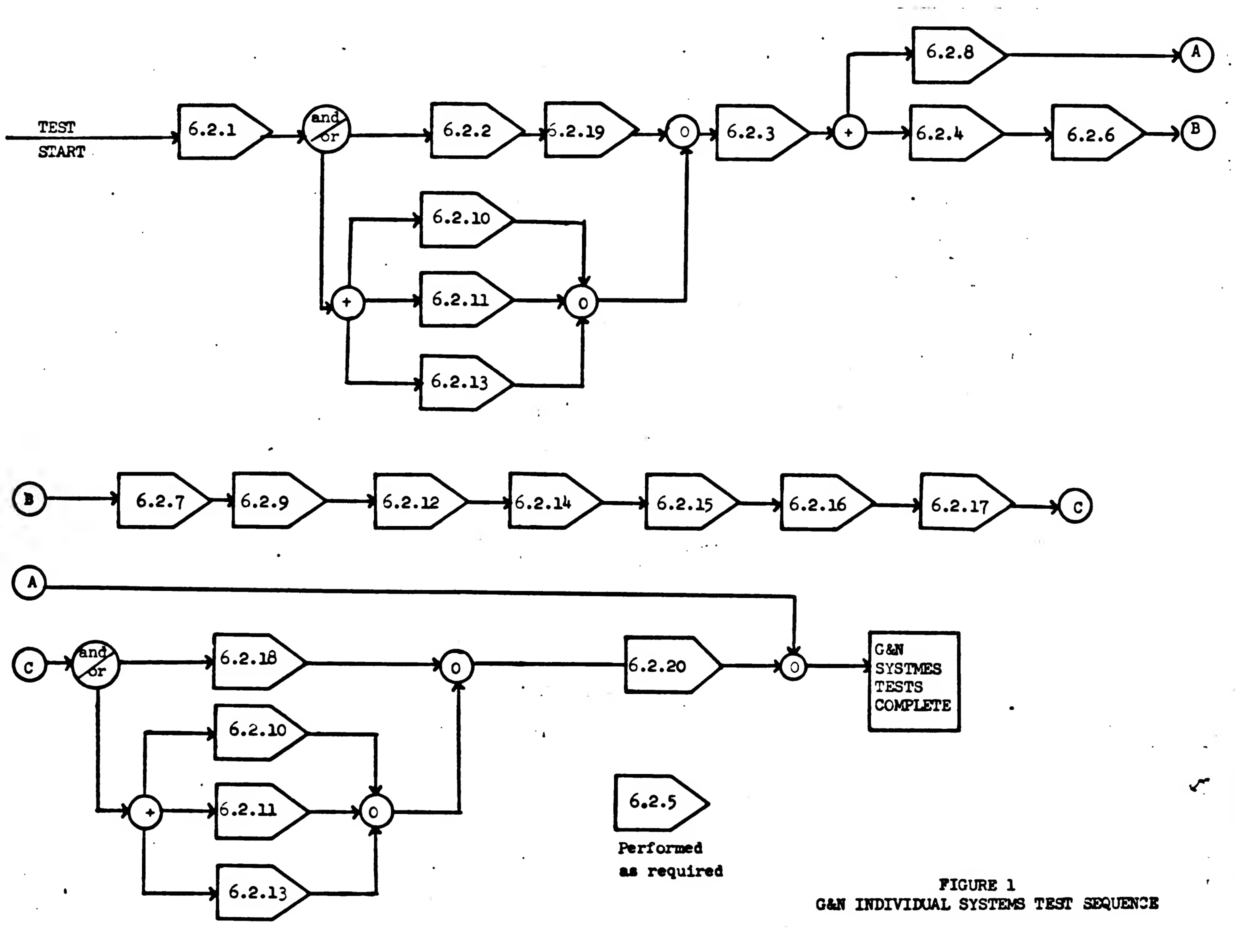
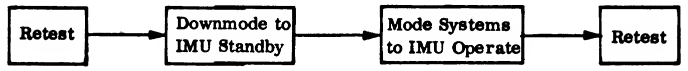


FIGURE 1
G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

5.4.2 Failure of the D criteria for IRIG and PIPA parameters.

5.4.2.1 If D_1, D_2, or D_3 exceeds its maximum value as specified in Table D, Paragraph 6.2.16.10.8 for any IRIG or PIPA, a retest sequence shall be initiated as indicated below:



RETEST SEQUENCE

The retest sequence shall be performed using the paragraphs indicated in Table I corresponding to the out-of-spec parameters. Table 2 indicates the test positions and other isolated parameters that must be recalculated and qualified.

If D_1, D_2, or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2 (IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1, D_2, and D_3 are within tolerances specified in Table D after the retest sequence is completed, the original out-of-tolerance D terms calculated in paragraph 6.2.16.10.8 shall be exonerated.

5.4.2.2 IRIG stability requirements.

5.4.2.2.1 Failure to be within the maximum values for D_1 or D_2 or D_3 after the retest sequence shall constitute failure of the unit.

5.4.2.3 PIPA stability requirements.

5.4.2.3.1 Failure to be within the maximum limits of D_1 or D_2 or D_3 after the retest sequence constitute failure of the unit.

O.O.S. PARAMETERS	PARAGRAPH NUMBERS																																																							
	6.2.16.1 thru 6.2.16.7.7	6.2.16.7.X where X is listed below																																																					
		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
NBDX	X															X	X	X																																						
NBDY	X	X	X	X																																																			X	X
NBDZ	X							X	X	X																																													X	X
ADSRAX	X															X	X	X																					X	X	X	X													X	X
ADSRAY	X	X	X	X																	X	X	X	X																															X	X
ADSRAZ	X							X	X	X																																					X	X	X	X					X	X
ADSRAX	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X																																					X	X
ADIAY	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X																					X	X	X	X									X	X	X	X	X	X
ADIAZ	X							X	X	X					X	X	X	X			X	X	X	X	X	X	X	X																											X	X
X PIPA BIAS & S.P. ERROR	X	X	X	X	X	X	X	X	X	X	X	X																																											X	X
Y PIPA BIAS & S.P. ERROR	X																													X	X	X	X	X	X	X	X	X	X	X	*														X	X
Z PIPA BIAS & S.P. ERROR	X															X	X	X	X	X	X	X	X	X	X	X																													X	X

* Perform step and wait 20 sec. before proceeding.

TABLE 1

TABLE 2

O.O.S. PARAMETER	PERFORM POSITIONS	PARAMETERS TO BE REQUALIFIED
NBDY	1	NBDY
NBDZ	2	NBDZ
NBDX	3	NBDX
ADSRAY	1 and 4	ADSRAY, NBDY
ADSRAZ	2 and 9	ADSRAZ, NBDZ
ADSRAX	3 and 7	ADSRAX, NBDX
ADIAY	1 thru 3, 7 and 10	NBDY, NBDX, ADIAX, ADSRAX, ADIAY, NBDZ
ADIAZ	2 thru 4	NBDZ, NBDX, ADIAZ
ADIAX	1 thru 3	NBDX, NBDZ, ADIAX, NBDY
X PIPA Bias or S.F.	1 thru 2	X PIPA BIAS, NBDY, NBDZ, X PIPA S.F.
Y PIPA Bias or S.F.	5 and 6	Y PIPA BIAS Y PIPA S.F.
Z PIPA Bias or S.F.	3 and 4	Z PIPA Bias, NBDX Z PIPA S.F.

5.5 Retest subsequent to replacement of a malfunctioned assembly with that of a flight certified assembly shall be at the discretion of NASA Engineering. Table II can be used as a guide to determine general retest requirements. In all retest procedures, the test sequence of Figure 1 shall be adhered to.

5.5.1 The resistance between the CMC case and structural ground shall be less than .05 ohms.

5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.

5.7 The following requirements shall be completed before any of the tests in this specification are attempted.

5.7.1 The G&N System shall be Government Furnished Property.

5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II MA0308-0107.

5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.

5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

TABLE II. RETEST MATRIX

Paragraph Number	Test Title	IMU	NAV BASE	OPTICS	CMC	PSA	LEB DSKY	MDC DSKY	SIG. COND.	CDU	G&N HARNESS	PIPA ELECT.	INDICATOR CONTROL PANEL
5.5.1	AGC Ground Check												
6.2.1	Application of Standby Power to G&N System	X	X		X	X	X	X	X	X	X	X	
6.2.5	General Turn Off and Turn On Procedure	*		*	*	*	*	*	*	*	*	*	*
6.2.3	Operate Power On Test	X	X		X	X			X	X	X	X	
6.2.2	CMC Operational Test				X		X	X		X	X		X
6.2.8	G&N Panel Brightness and Lamp Test	X	X	X		X					X		X
6.2.6	G&N Operational Test	X	X		X	X				X	X	X	
6.2.10	Zero Optics Test		X	X	X	X			X	X	X		X
6.2.13	Optics Slew Rate Test		X	X	X	X			X	X	X		X
6.2.11	Optics Coordinate Transformation Control		X	X		X					X		X
6.2.12	Optics Function Test - VAB and PAD		X	X	X	X				X	X		X
6.2.9	Semi-Automatic Mode Control Test	X	X	X	X	X			X	X	X		
6.2.14	Stab Loop Step Response Test	X	X			X			X				
6.2.15	IRIG Scale Factor Test	X	X			X							
6.2.16	IMU Performance Test	X	X			X						X	
6.2.17	Fine Alignment Test	X	X	X	X					X	X		
6.2.19	Voltage Margin Test				X					X	X		
6.2.7	Gimbal Friction Test	X	X						X		X		
6.2.18	Gyrocompassing Test**	X	X			X						X	
6.2.4	G&N Power Supplies Test		X		X	X			X	X	X	X	
6.2.20	S/C Control & Display Test				X					X	X		

* To be used as necessary to turn system on and off.

** [illegible], it shall [illegible] performed for a [illegible] the 2 hour [illegible].

5.8 **The following conditions are required for testing the G&N System.**

5.8.1 **Spacecraft systems other than the G&N System may be operating on a noninterfering basis while individual system checkout of the G&N System is being conducted.**

5.8.2 **The G&N System shall be supported by the Electrical Power System and Environmental Control System during operation in the Command Module. The Stabilization and Control System shall be connected to the G&N System during G&N operation in the Command Module for passive loading purposes if available.**

5.8.3 **During tests which interface with the Stabilization and Control System and the Central Timing System, operation of these systems shall be required.**

5.9 **The G&N System shall be tested per this specification after it is installed in the spacecraft. In the event that the installed system, or any assembly thereof, is removed from the spacecraft for modification, recycle, or any other reason, this process specification or pertinent portions of it shall be performed after the G&N System or assembly thereof, is reinstalled. Testing shall be limited to G&N System operation while actively connected to qualified spacecraft threshold systems, namely, the Electrical Power System (EPS), Environmental Control System (ECS), and Communication and Instrumentation System (C&IS) as much as possible. However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS). However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS), Central Timing System (CTS) and Caution and Warning System is required for complete G&N System Verification.**

5.10 The test equipment listed in paragraph 4.1 shall be connected and ready for operation before the tests of this specification are initiated.

5.11 **Data Records**

5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out of tolerance readings shall be recorded and flagged by appropriate symbols.

5.11.1.1 All test data obtained while demonstrating the requirements of this document shall be permanently recorded and forwarded to the next receiving agency.

5.11.1.2 A record of the amount of time each of the four prime power busses are on shall be kept and forwarded to the next receiving agency.

5.12 **Interface**

5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface in accordance with the applicable ICD's.

6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then the heater power shall be supplied through the Portable Temperature Controller (PTC) Model No. S23-011. The temperature of the IRIG's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MNA, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period, but not less than 15 minutes, shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyro and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.

6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.

a. UP TLM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.

b. LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IU.

c. The SC CONT switch on MDC Panel 1 shall be set to CMC.

d. The CMC MODE switch on MDC Panel 1 shall be set to AUTO.

e. The V CG switch on MDC Panel 1 shall be set to CSM.

f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.

g. The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.

6.1.2 Deleted.

6.1.3 Deleted.

6.1.4 Emergency Shutdown Procedure

CAUTION: In the event of a malfunction occurence which could damage the G&N System before the normal shutdown procedure 6.2.5 could be performed, the following sequence should be utilized in the spacecraft.

6.1.4.1 On the LEB Lighting Control Panel set the G/N POWER-IMU and G/N POWER - OPTICS switches to OFF.

6.1.4.2 On the Right Hand Circuit Breaker Panel set the following switches and circuit breakers to OFF (breakers pulled out).

a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B

b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B

c. G/N POWER switch to OFF

d. GUIDANCE/NAVIGATION IMU MN A and MN B

e. GUIDANCE/NAVIGATION OPTICS MN A and MN B

f. GUIDANCE/NAVIGATION POWER AC 1 and AC 2

6.1.4.3 Verify that the PTC is providing heater power to the G&N System.

6.2 Test Procedures

6.2.1 Application of Standby Power to G&N System

6.2.1.1 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.

6.2.1.2 The Portable Temperature Controller (PTC), shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.

6.2.1.3 Computer Power On

6.2.1.3.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).

6.2.1.3.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.

6.2.1.3.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.

6.2.1.3.4 The +28 VDC CMC OPERATE voltage (CG 1520) shall be +28.8±3 VDC. Verify CRT indication.

6.2.1.3.5 Using DSKY, enter VERB 36, ENTR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.

6.2.1.3.6 The voltage output of the +4 VDC CMC supply shall be +4.00±0.20 VDC, (CG1030). The value on the CRT shall be recorded.

6.2.1.3.7 The voltage output of the +14 VDC CMC supply shall be +14.0±0.4 VDC, (CG1020). The value on the CRT shall be recorded.

6.2.1.3.8 IMU HTR Heater Power On

6.2.1.3.8.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

NOTE: Restart Lamp may illuminate, if it does, disregard and press RSET on the DSKY.

6.2.1.3.8.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513).

6.2.1.3.8.3 Record the value of the following signals displayed on the CRT.

	Signal	Requirement
a.	CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6±0.6 VRMS
b.	CG 1510 + 28 VDC STANDBY POWER	28.8±3 VDC

6.2.1.3.8.4 The PIPA TEMP on the CRT shall be monitored at 15 min., 1 hr. and 2 hrs. from execution of 6.2.1.4.1 to insure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 130.5±1.5°F (CG2300).

6.2.1.3.8.5 At the termination of the 2-hour period, record the PIPA temperature (CG2300) on the CRT. On the event recorder verify that the IMU HEATER current discrete (CG2302) is ON and that the IMU BLOWER current discrete (CG2303) is OFF over the last two hour period (occasionally discretes may cycle).

6.2.1.3.8.6 With the eyepiece in the Eyepiece Storage Unit, check the eyepiece surface temperature at the quick disconnect flange using an L&N #8693 Temperature Potentiometer, or a similar type thermocouple probe meter. Record both the ambient and eyepiece surface temperatures and verify that the eyepiece surface temperature is at least 10°F above the ambient temperature.

6.2.1.3.9 Zero the CMC erasable memory by entering the following sequence into the K-start:

a. VERB 92, ENTER
b. 00015, ENTER

6.2.1.3.10 Initiate CMC self-check by entering the following sequence into the K-start:

a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER
c. VERB 05 NOUN 01, ENTER
d. 1366, ENTER

6.2.1.3.10.1 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the PROGRAM ALARM lamp on the DSKY's shall light.

6.2.1.3.10.2 Enter the following into the K-start:

a. VERB 21
b. NOUN 27, press ENTER pushbutton
c. 00000, press ENTER pushbutton

6.2.2 CMC Operational Test

NOTE: Verify that IMU STANDBY power (including CMC operate power) is applied, IMU OPERATE Power is not applied. (G&N IMU HTR MN A and MN B breakers engaged, Computer MN A and MN B breakers engaged, IMU MN A and MN B breakers disengaged, G/N Power-IMU switch on LEB Lighting Control Panel in OFF Position).

6.2.2.1 Using the LEB CMC DSKY, enter the following sequence of data into the CMC to initiate the DSKY check. Press the ENTER pushbutton after each entry (denoted by E).

VERB 36, E Press RESET

VERB 21 NOUN 27, E

77766, E

6.2.2.2 DSKY check shall check all the electroluminescent elements by displaying the decimal numbers from nine through zero in succession, each set of numbers shall be displayed for approximately 5 seconds. Verify all elements operable on MDC and LEB CMC DSKY's. VERB-NOUN display shall flash.

6.2.2.2.1 Minus and plus signs shall be displayed. Verify operation on MDC and LEB DSKY's.

6.2.2.2.2 COMP ACTY lamp shall be illuminated for approximately 5 seconds, then DSKY shall blank.

6.2.2.3 CAUTION and STATUS Displays

6.2.2.3.1 Enter VERB 35, ENTR, into LEB CMC DSKY.

6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 seconds.

a. UPLINK ACTY
b. NO ATT
c. STBY
d. KEY REL Flashing
e. TEMP
f. GIMBAL LOCK
g. PROG
h. RESTART
i. TRACKER
j. OPR ERROR Flashing
k. COMP ACTY
l. VERB-NOUN Flashing
m. Plus 88888 in R1, R2, and R3
n. PGNCS. CMC. ISS Warning lights (CMC shall remain illuminated for 15±5 seconds.

After indications a through l go out +88888 shall remain in R1, R2, R3.

6.2.2.4 **DSKY Pushbutton Check**

6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).

a. VERB 25 NOUN 01, E
b. 02100, E
c. +00123, E
d. -00456, E
e. -00789, E

6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.

6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.

6.2.2.4.4 Enter 02100 into LEB CMC DSKY. Press the ENTER pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.

6.2.2.4.5 Enter the following sequence into the LEB CMC DSKY.

a. VERB 21 NOUN 01, ENTER
b. 02100, ENTER
c. +00123, DO NOT press ENTER

6.2.2.4.5.1 Press the CLEAR pushbutton. R1 shall clear.

6.2.2.4.6 Enter VERB 16 NOUN 36 into the LEB CMC DSKY. Press the ENTER pushbutton. The operator Error Light shall light.

6.2.2.4.6.1 Press the RESET pushbutton. The Operator Error light shall extinguish.

6.2.2.4.7 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton as indicated. The Key Release Light shall light.

a. VERB 16, NOUN 20, ENTER
b. VERB

6.2.2.4.7.1 Press the KEY RELEASE pushbutton. The Key Release light shall extinguish.

6.2.2.4.7.2 Enter VERB 36, into the LEB CMC DSKY. Press the ENTER pushbutton.

NOTE: 6.2.2.4.8 does not apply to 2TV-1.

6.2.2.4.8 Enter the following sequence into the LEB CMC DSKY.

a. VERB 11 NOUN 10, ENTER
b. 00032, ENTER

Press the STANDBY proceed pushbutton once and verify that "5XXXX" is displayed in R1. Press the STANDBY pushbutton again and verify that "7XXXX" is displayed in R1. Enter VERB 34 and press the ENTER pushbutton.

6.2.2.4.9 Repeat 6.2.2.4.1 through 6.2.2.4.8 using the MDC CMC DSKY.

6.2.2.5 Uplink and Downlink Checks.

6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.

6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

a. VERB 25 NOUN 01 ENTER
b. 02100, ENTER
c. 00000, ENTER
d. 77777, ENTER
e. 07254, ENTER
f. VERB 05 NOUN 01, ENTER
g. 02100, ENTER

6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.

6.2.2.5.4 Set/Verify that the UP TLM switch on the Main Display Panel is set to ACCEPT and that the UP TLM switch on the G&N Indicator Control Panel is set to BLOCK.

6.2.2.5.5 On K-148 insert VERB.

Verify that the VERB indication on the DSKY and CRT does not change.

6.2.2.5.6 Set the UP TLM switch on the G&N Indicator Control Panel to ACCEPT. Verify that the BLOCK UPLINK discrete is OFF.

6.2.2.5.7 On K-148 insert VERB 01. Verify that the VERB indication on the DSKY and CRT is 01.

6.2.2.5.8 Set the UP TLM switch on the MAIN DISPLAY Panel to BLOCK. Verify that the BLOCK UPLINK discrete is ON.

6.2.2.5.9 On K-148 insert VERB. Verify VERB indication on the DSKY and CRT does not change.

6.2.2.5.10 Set the UP TLM switch on the MAIN DISPLAY Panel to ACCEPT. Verify that the BLOCK UPLINK discrete is OFF.

6.2.2.5.11 On K-148 insert VERB 36. Press the ENTER pushbutton.

6.2.2.6 Deleted

6.2.2.7 Parity Fail Test

6.2.2.7.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

a. VERB 92, ENTER
b. 00015, ENTER
c. VERB 21 NOUN 02, ENTER
d. 02100 ENTER
e. 33777, ENTER
f. VERB 25 NOUN 26, ENTER
g. 04000, ENTER
h. 01500 ENTER
i. 00004 ENTER
j. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 09 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.7.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

6.2.2.8 Rupt Lock Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

a. VERB 24 NOUN 01, ENTER
b. 02100, ENTER
c. 30001, ENTER
d. 01600, ENTER
e. VERB 25 NOUN 26, ENTER
f. 00001, ENTER
g. 01500, ENTER
h. 00004, ENTER
i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 09 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.2.9 TC Trap Test

6.2.2.9.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

a. VERB 21 NOUN 02, ENTER
b. 02100, ENTER
c. 01500, ENTER
d. VERB 25 NOUN 26, ENTER
e. 04000, ENTER
f. 01500, ENTER
g. 00004 ENTER
h. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 09 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.9.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.9.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.2.10 Nightwatchman Test

6.2.2.10.1 Enter the following sequence into the K-Start. Press ENTER pushbutton after each entry.

a. VERB 24 NOUN 01, ENTER
b. 02100, ENTER
c. 30001, ENTER
d. 01500, ENTER
e. VERB 25 NOUN 26, ENTER
f. 04000, ENTER
g. 01500, ENTER
h. 00004, ENTER
i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 09 shall be displayed on MDC and LEB CMC DSKY and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.10.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.10.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.2.11 Bank Sum Check

6.2.2.11.1 From a program listing for the installed CMC ropes, obtain a list of bank CKSM bugger words.

6.2.2.11.2 Enter VERB 91, ENTER into K148.

6.2.2.11.3 Record the following:

R1 = Bank Sum
R2 = Bank Number
R3 = Bank CKSM bugger word

R1 shall be the same or the complement of R2.
R3 shall equal the CKSM bugger word for the indicated bank.
Enter VERB 33, ENTER

6.2.2.11.4 Repeat 6.2.2.11.3 until all banks have been checked. Terminate the Bank Sum Test by entering VERB 34, ENTER into K148.

6.2.2.12 **CMC Clock Frequency Test.**

6.2.2.12.1 Insure that CMC operate power has been applied for a minimum of 10 minutes before performing this test.

6.2.2.12.2 Verify that the counter is connected to the 3.2 kc signal on the hardline.

6.2.2.12.3 Insure that the counter has been warming up for a minimum of 30 minutes.

6.2.2.12.4 On the counter,

Set the FUNCTION switch to: MAN START
Set the TIME BASE switch to: 1 usec TIME UNIT/COUNT
Set the SENSITIVITY control to: CHECK

6.2.2.12.5 Verify proper counter operation.

6.2.2.12.6 Set the FUNCTION switch to REMOTE OR TIME INTERVAL.

6.2.2.12.7 Plug in the Preset unit and set:

MODE switch to PRESET
N switches to 96000.

6.2.2.12.8 Turn SAMPLE RATE control fully clockwise (HOLD). Wait 35 seconds for counter display to fill.

6.2.2.12.9 Start counting by depressing RESET switch on counter.

6.2.2.12.10 After approximately 30 seconds, read and record counter display.

6.2.2.12.11 Repeat steps 6.2.2.12.9 and 6.2.2.12.10 nine times.

6.2.2.12.12 The average of the 10 previous readings shall be 30.000000±0.000060 seconds.

6.2.2.12.13 Insure that the system is not in IMU Operate.

6.2.2.12.14 Perform the following DSKY operations:

VERB 21	NOUN 10	ENTR
00013		ENTR
02000		ENTR

Press and hold the STBY pushbutton on the DSKY for 3 seconds. Verify the Standby lamp is lighted.

6.2.2.12.15 Repeat steps 6.2.2.12.9 through 6.2.2.12.12.

6.2.2.12.16 Press and hold the STBY pushbutton on the DSKY for 3 seconds. Verify the Standby lamp is not lighted.

6.2.2.13 Minimum Impulse Controller Input Test.

6.2.2.13.1 Enter the following into the DSKY.

a. VERB 11 NOUN 10, ENTER
b. 00032 - ENTER

6.2.2.13.2 Set the Minimum Impulse Controller on the Indicator Control Panel to the following position and observe R1 of the DSKY for the proper indications.

	MIC Position	R1 DSKY Indication
a.	Up	77775
b.	Down	77776
c.	Left	77737
d.	Right	77757
e.	Clockwise	77773
f.	Counterclockwise	77767
g.	Neutral	77777

6.2.2.13.3 Enter VERB 34, ENTER into the DSKY.

6.2.2.14 Mark and Mark Reject pushbutton test.

6.2.2.14.1 On the G&N Indicator Control Panel press and hold MARK pushbutton.

6.2.2.14.2 On the DSKY observe

Row 1 = 00114
Prog Alarm lamp is lighted
Press ERR RSET

6.2.2.14.3 Enter the following on K-148:

VERB 11 NOUN 10 ENTR
00016 ENTR

6.2.2.14.4 Observe that DSKY Row 1 displays 00040.

6.2.2.14.5 Release MARK pushbutton.

6.2.2.14.6 Observe that DSKY Row 1 displays 00000.

6.2.2.14.7 Press and hold the REJECT pushbutton on the G&N Indicator Control Panel.

6.2.2.14.8 On the DSKY observe

VERB 05 NOUN 31
Row 1 = 00112
Prog Alarm lamp is lighted
Press ERR RSET

6.2.2.14.9 Observe that DSKY Row 1 displays 00100.

6.2.2.14.10 Release the REJECT pushbutton.

6.2.2.14.11 Observe that DSKY Row 1 displays 00000.

6.2.2.14.12 On the DSKY perform the following operation:

VERB 36 ENTR

6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power ON

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of Step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)

b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)

c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

e. G/N Power - IMU set to OFF
f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G&N Indicator control panel shall be set as follows:

a. OPTICS MODE to MANUAL
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to MED
d. TELESCOPE TRUNNION to SLAVE to SXT
e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G&N Displays.

6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

a. CG 2117 IGA Servo Error In Phase
b. CG 2177 OGA Servo Error In Phase
c. CG 2147 MGA Servo Error In Phase
d. CG 2112 IG IX Resolver Output Sin
e. CG 2172 OG IX Resolver Output Sin
f. CG 2142 MG IX Resolver Output Sin
g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G&N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

a. Turn on the IMU MNA and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

b. Start Analog Recorders.

c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

a. The IMU Operate Power is +28.8±3 VDC (CG 1500). Verify on CRT.

b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

CG 2112, IG IX Resolver Output Sin
CG 2142, MG IX Resolver Output Sin
CG 2172, OG IX Resolver Output Sin

c. On the CRT, verify that the following signals are between +3 to +5 Vrms or -3 to -5 Vrms for a period of approximately 90 sec. After approximately 100 sec the following signals shall be less than ±1.0 Vrms.

CG 2001 X PIPA SG OUTPUT IN PHASE
CG 2021 Y PIPA SG OUTPUT IN PHASE
CG 2041 Z PIPA SG OUTPUT IN PHASE

d. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90±10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read +120±6 Vdc.

e. Stop the analog recorders.

6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.

a. CMC Warning
b. ISS Warning
c. PGNS Caution

6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light.

6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000±00150. Verify on CRT.

6.2.3.1.10 Enter the following into K-148:

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.3.1.11 Verify that the following secondary power supply voltages are not flashing on the CRT display.

TABLE VI. SECONDARY POWER SUPPLY VOLTAGES

	Meas. No.	Signal
1.	CG 1040	+120 VDC PIPA SUPPLY
2.	CG 1051	+20 VDC PIPA SUPPLY
3.	CG 1052	-20 VDC PIPA SUPPLY
4.	CG 1070	+4 VDC CDU SUPPLY
5.	CG 1100	-28 VDC ELECTRONICS
6.	CG 1020	+14 VDC CMC SUPPLY
7.	CG 1030	+4 VDC CMC SUPPLY
8.	CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9.	CG 1202	IMU 28V 800 CPS 5 pct ph A
10.	CG 1203	IMU 28V 800 CPS 5 pct ph B
11.	CG 1331	3.2KC 28V SUPPLY
12.	CG 1110	2.5 VDC TM BIAS

6.2.3.1.12 15 minutes after the application of IMU OPERATE power record PIPA TEMP (CG 2300) displayed on the CRT.

6.2.3.1.13 30 minutes after the application of IMU OPERATE power record IRIG TEMP (CG 2301) displayed on the CRT.

6.2.3.1.14 1 hour after the application of IMU OPERATE power monitor and record PIPA TEMP (CG 2300) and IRIG TEMP (CG 2301) every 5 minutes for 1 hour. Verify that each reading does not deviate from the average of each signal by more than 0.1°F.

6.2.3.1.15 When 2 hours have elapsed since the application of IMU OPERATE power record PIPA TEMP and IRIG TEMP. PIPA TEMP shall be 130.5±1.5°F, IRIG TEMP shall be 135±2.5°F. PIPA TEMP shall be within 0.5°F of that recorded in 6.2.3.1.12 and 6.2.1.5.4. IRIG TEMP shall be within 0.5°F of that recorded in 6.2.3.1.13.

6.2.3.2 Optics Power ON

6.2.3.2.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power - OPTICS switch on the LEB Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is +28.8±3 VDC. Record the indication on the CRT.

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POST INSTALLATION CHECKOUT PROCESS SPECIFICATION FOR THE APOLLO GUIDANCE & NAVIGATION SYSTEM BLOCK II-KSC

Record of Revisions

Date	Revision Letter	TDRR No.	Pages Revised

This specification consists of page 1 to 119 inclusive.

APPROVALS	NASA/MSC	2/17/67	ACED

1. INTRODUCTION

1.1 The individual Spacecraft (SC) installed Guidance and Navigation (G&N) System to be checked out per this process specification shall consist of one of each of the following major assemblies: The applicable part numbers shall be determined by drawing No. 2014999.

1 - Optical Unit Assembly
1 - Navigation Base Assembly, Block II
1 - Inertial Measurement Unit (IMU) & PIPA Elect. Assy.
1 - Power and Servo Assembly (PSA)
1 - Apollo Guidance Computer Group
1 - G&N Interconnect Harness Assembly
1 - Signal Conditioner Assembly
1 - Display and Control Group (D & C)
1 - Coupling Data Unit

1.2 The G&N System herein shall be identified as a Block II system. The computer contains the program flight ropes in the core rope memory.

2. SCOPE

2.1 This specification outlines the checkout requirements for the G&N System installed in the Apollo Command Module Spacecrafts.

2.2 This document is to be used as technical support for all Block II G&N System test documentation for Command Module spacecraft testing. This document shall be amended by addendum to support applicable hardware, mission or program differences.

3. APPLICABLE DOCUMENT

3.1 Documents Required by this Specification

3.1.1 When the requirements of this specification conflict with the drawing requirements, the drawing requirements shall have precedence.

PS 2015000	Master End Item Specification, Part II, Product Configuration and Acceptance Test Requirements, G&N Spacecraft Equipment Command Module, Block II
ICD MH01-01307-216	CDU to TVC Servo Amps Electrical Block II
ICD MH01-01324-216	Attitude Error Signals Electrical Block II
ICD MH 01-01325-216	Total Attitude Signals
ICD MH01-01327-216	G&N Electrical Input Power
ICD MH01-01328-216	G&N Data Transmission to Operational and Flight Qual. Telemetry
ICB MH01-01342-216	G&N System Caution and Warning System Interface
ICD MH01-01349-416	G&N Thermal Requirements for Block II AGE
ICD MH01-01344-216	Mode Control Signals S/C to ISS Discretes
ICD MH01-01335-200	Electrical Inertial Temperature Controller
ICD MH01-01380-216	Command Module Guidance Computer Electrical Interfaces Block II
ICD MH01-01386-216	Attitude Error to SIVB
MH01-01390-200	G&N PSA Adapter Module ACE-S/C DTMS and DTCS Block II Vehicles.
MA0201	ACE-S/C Computer Subprogram Program Requirements S/C 101 KSC
MA0308-0107	Mechanical Installation Specification for Apollo Guidance Equipment
MA0610-018A	Contamination Control-Apollo Command Module and Service Module
SID 65-1642	Apollo Command Module/Service Module Measurement Requirements for Block II

4.0 MATERIAL AND EQUIPMENT

4.1 The following test equipment shall be used to perform the requirements of this specification. If protection to personnel and equipment is not decreased, items, except government furnished parts, equivalent to those listed may be used.

ITEM	QUANTITY	DESCRIPTION
1	1	Digital Test Measurement System Model No. C14-208
2	1	Digital Test Command System, Model No. C14-207
3	1	Data Interleaver System, Model No. C14-232
4	1	External Digital Test Command Unit Model No. C14-231
5	1	S/C Ground Power Supply Model No. C14-418
6	1	Breakout Box, Test, CM-SM Adapter Model No. C14-467
7	1	Electrical Cable Set Model No. C34-391.
8	1	Inertial Components Temperature Controller (ICTC) Model No. 513-100
9	1	PSA Adapter Module, Model No. A23-304
10	1	Optics Supporting Fixture Model No. A14-135
11	1	G&N Installation Qualification Fixture, Model No. A23-097
12	1	Theodolite (DKM 3 or equivalent) Model No. A23-079).
13	1	Retroflecting Prism, Model No. A23-200
14	1	Portable Light Assembly Model No. A23-196
15	1	Vacuum Tube Volt Ohmmeter(VTVOM)
16	1	Calculator (Friden or equivalent)
17	1	Movable Optics Target
18	1	SCT Resolution Check Card
19	1	Electrical Cable Portable G&N System, Model No. C14-462
20	1	Electronic Counter with Preset Counter (Hewlett Packard 5245L with 526A Preset Plug-In Unit, or equivalent)
21	1	Cable Set, SMD9-17166
22	1	Stopwatch
23	1	Cable Set, SMD9-17167
24	1	Test Box, SMD9-17003

5.0 GENERAL REQUIREMENTS

5.1 Safety Requirements

5.1.1 Operator Safety

5.1.1.1 Normal Safety precautions shall be observed throughout the G&N post-installation checkout.

5.1.2 Equipment Safety

5.1.2.1 To preserve the operational life of the components of the G&N Hardware under test, settings and adjustments shall be performed only when specified in the test procedure. Care shall be exercised in the accomplishment of all settings and adjustments to avoid excessive wear or damage to the equipment. All precautionary measures stated throughout the test procedures shall be strictly adhered to.

5.1.2.2 In no event shall the Inertial Components Temperature Controller (ICTC) be disconnected from connector 45J2 of the PSA except when specified to do so in a specific test.

5.1.2.3 The generation of noise alarm indication, as evidenced by one or more Noise Peak Event lights becoming lighted, shall be cause for immediate determination of effects on the G&N System Test in progress. In the event of detrimental effects on the system test, trouble shooting procedures shall be initiated to determine the cause of the alarm. Testing shall continue only after demonstrating that the cause of the noise alarm has been located and that remedial action has been or will be taken, or that the transient or noise causing the alarm has no detrimental effect on the G&N System or test in progress.

5.1.2.4 Failure of the G&N System to pass any examination or test specified herein shall tentatively classify the G&N System as nonconforming. The normal test sequence may be continued on determination of the cause of the nonconformance if not detrimental to the G&N System on other interfacing subsystems. This determination shall have the concurrence of the G&N contractor test team. All nonconformance shall be investigated and cleared by waiver, (FNN), correction of test specification, or hardware replacement. The suspected malfunctioning hardware shall be removed and returned to the laboratory, where the malfunction shall be verified. Only after malfunction verification shall a flight certified replaceable unit be installed in the G&N System.

5.1.2.5 The G&N System shall be operating in STANDBY mode with CMC power applied for a minimum of two hours prior to torquing of inertial components. In the event STANDBY or CMC power is interrupted, an equivalent time period shall be allowed when power is restored before transfer to the OPERATE mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory. Exceptions to the above are noted in 6.2.5.2.

5.1.2.6 The interruption of +28 VDC power to the G&N System through the Main A and Main B power busses shall be cause for the Command Module G&N System operator to immediately initiate the Emergency shutdown procedure (6.1.4) to preclude damage to the G&N System.

5.1.2.7 The SCT and SXT eyepieces shall be stowed whenever the instruments are not in use to preclude damage to them. It shall be necessary to install the eyepieces when testing requires use of the instrument.

5.1.2.8 To preserve the operational life of the components of the MDC and LEB DSKY's, the monitor routines shall be used only when required by test procedure or trouble shooting. Such routines shall be terminated as quickly as possible in the test flow. Computer routines which cause the DSKY display to flash (either requesting data or displaying data) shall also be terminated as quickly as possible.

5.2 Standard Environmental Conditions

5.2.1 The G&N System when installed in the Command Module shall be tested in an environment in accordance with ICD MH01-1348-416. At no time shall the dust particle count exceed Level 3000,000 of Federal Standard 209 with no more than 2,000 particles per cubic foot larger than 5 microns; no more than 35 particles larger than 65 microns with no more than 3 of these 35 larger than 100 microns in existence. Dust covers shall be installed on the SXT and SCT per KD MH01-01350-116 when optics are not under test.

5.2.1.1 For periods of G&N Testing with the optical heads and the eyepieces of the SCT and SXT of the C/M G&N uncovered, or with the eyepieces removed, the environment shall meet at least the Class 100,000 particle size and count.

5.2.1.2 With the optical heads covered and the eyepieces installed or covered on the optical components (SXT, SCT), the ambient environment shall meet the following conditions for particle size and count. No more than 1,400 particles 5.0 microns or larger per cubic foot.

5.2.2 The APOLLO G&N System shall interface with a qualified ECS distribution system which shall supply coolant fluid during STANDBY and OPERATE control modes with flow rates and inlet temperatures as specified in ICD MH01-01349-416.

5.3 Test Equipment Tolerances

5.3.1 Measurements and tolerances are specifications stated herein are basic G&N System performance specifications. Calibration data must be supplied to the Acceptance Checkout Equipment (ACE) for the Power and Servo Assembly Adapter Module (PSAAM) and Signal Conditioner Assembly (SCA) performance. Final tolerances must include PSAAM and Signal Conditioner stability uncertainties (see appendix 1) as well as ACE and ACE carry-on conditioning uncertainties. All uncertainties due to instrumentation shall be root sum squared with the basic subsystem tolerance to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.

5.4 Test Sequence

5.4.1 The test sequence should follow the flow chart of Figure 1, except for 6.2.5, Turn-On and Turn-Off procedure, which may be performed as the requirement arises.

TABLE I

Paragraph No.	Test Title
6.2.1	Application of Standby Power to G&N System
6.2.2	CMC Operational Test
6.2.3	Operate Power On Test
6.2.4	G&N Power Supplies Test
6.2.5	General Turn Off and Turn On Procedures
6.2.6	G&N Operational Test
6.2.7	Gimbal Friction Test
6.2.8	G&N Panel Brightness & Lamp Test
6.2.9	Semi-Automatic Mode Control Test
6.2.10	Zero Optics Test
6.2.11	Optics Coordinate Transformation Control Test
6.2.12	Optics Positional Accuracy Test
6.2.13	Optics Slew Rate Test
6.2.14	Stabilization Loop Step Response Test
6.2.15	IRIG Scale Factor Test
6.2.16	IMU Performance Test
6.2.17	Fine Alignment Test SXT-NB-IMU
6.2.18	Gyrocompassing Test
6.2.19	Voltage Margin Test
6.2.21	S/C Control & Display Test

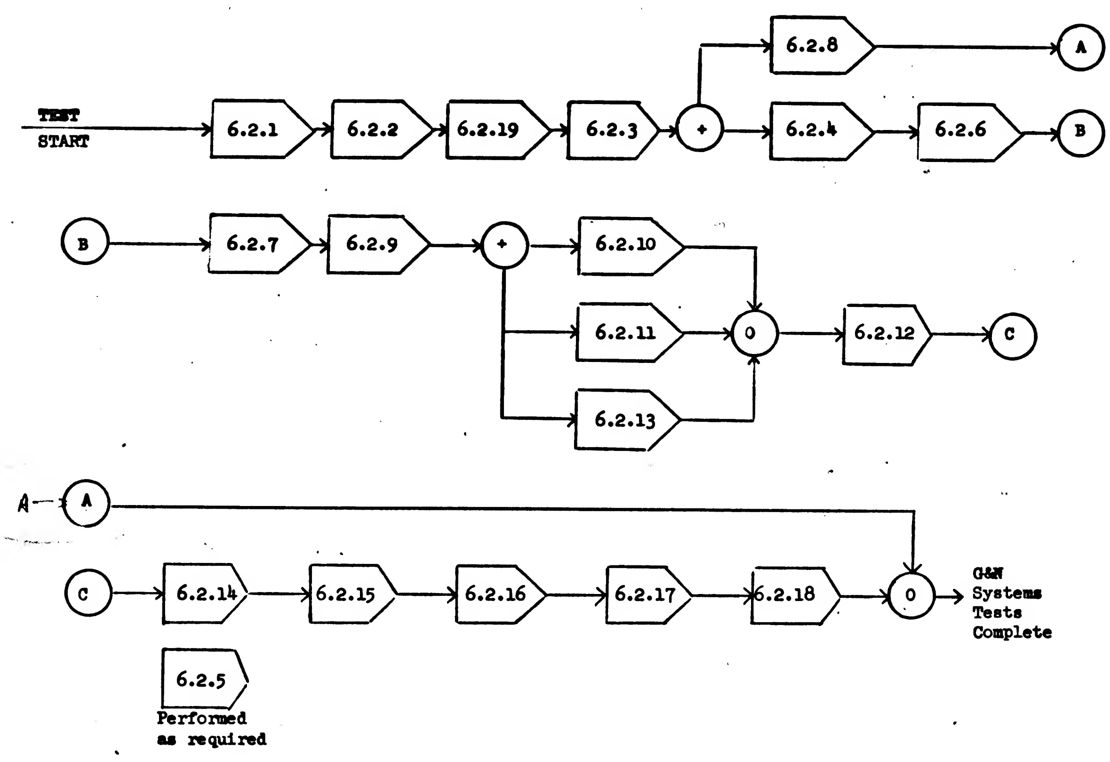


FIGURE 1
G&N INDIVIDUAL SYSTEMS TEST SEQUENCE

5.5 After the defective, replaceable element has been substituted with a flight certified unit, the G&N System checkout sequence shall regress to the rerunning of applicable portions of the selected sequence (by paragraph number) categorized by the subassemblies in which the malfunction occurred. The chosen subassembly categories are presented in Table II versus an appropriate retest paragraph sequence. Retest shall be conducted by performing applicable portions of all indicated paragraph numbers in the sequence listed as indicated under the appropriate subassembly heading. Retest shall proceed to the point in the normal test sequence at which the discrepancy was detected and corrected. Normal testing shall continue beyond this point in the specified sequence of Figure I.

5.6 It is assumed that the Test Conductor has a working knowledge of the test equipment used; therefore, this procedure contains only the steps related directly to the G&N System components. If any questions arise concerning the test equipment, the Test Conductor should refer to the pertinent operational manuals.

5.7 The following requirements shall be completed before any of the tests in this specification are attempted.

5.7.1 The G&N System shall have been qualified in accordance with the requirements of PS 2015000.

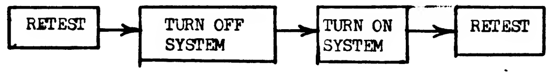
5.7.2 The installation of the G&N System into the spacecraft shall have been completed as specified in Mechanical Installation Specification for Apollo Guidance Equipment Block II: MA0308-0107.

5.7.2.1 Interfacing systems (SCS, C & IS, EPS, ECS) shall have been verified to conform to loading and operational requirements as specified by the appropriate ICD.

5.7.3 All ACE equipment shall have been qualified in accordance with the respective quality assurance specifications prior to use with the G&N System.

5.4.2 Failure of the D criteria for IRIG and PIPA parameters.

5.4.2.1 If D_1, D_2, or D_3 exceeds its maximum value as specified in Table D of 6.2.16.10.7 for any IRIG or PIPA, that IRIG or PIPA shall be retested in the sequence indicated below. The coefficient stability terms shall be recalculated.



RETEST SEQUENCE

If D_1, D_2, or D_3 exceeds its maximum value after the retest sequence is completed, the requirements of 5.4.2.2 (IRIG) or 5.4.2.3 (PIPA) shall apply. If D_1, D_2, and D_3 are within the tolerances specified in Table D of 6.2.16.10.7 after the retest sequence is completed, the original out-of-tolerance D terms calculated in 6.2.16.10.8 shall be exonerated.

5.4.2.2 Stability Requirements

5.4.2.2.1 Failure to be within the maximum values for D_1, D_2, or D_3 after the retest sequence shall constitute failure of the unit.

TABLE II. RETEST SEQUENCE

Paragraph Number	Test Title	IMU	NAV BASE	OPTICS	CMC	PSA	LEB DSKY	MDC DSKY	SIG. COND.	CDU	G&N HARNESS	PIPA ELECT.	INDICATOR CONTROL PANEL
6.1.3	Pre-Power Application Tests	X	X	X	X	X	X	X	X	X	X	X	X
6.2.1	Application of Standby Power to G&N System	X	X		X	X	X	X	X	X	X	X	
6.2.5	General Turn Off and Turn On Procedure	*		*	*	*	*	*	*	*	*	*	*
6.2.3	Operate Power On Test	X	X		X	X			X	X	X	X	
6.2.2	CMC Operational Test				X		X	X		X	X		X
6.2.8	G&N Panel Brightness and Lamp Test	X	X	X		X					X		X
6.2.6	G&N Operational Test	X	X		X	X				X	X	X	
6.2.10	Zero Optics Test		X	X	X	X			X	X	X		X
6.2.13	Optics Slew Rate Test		X	X	X	X			X	X	X		X
6.2.11	Optics Coordinate Transformation Control		X	X		X					X		X
6.2.12	Optics Positional Accuracy Test		X	X	X	X				X	X		X
6.2.9	Semi-Automatic Mode Control Test	X	X	X	X	X			X	X	X		
6.2.14	Stab Loop Step Response Test	X	X			X			X				
6.2.15	IRIG Scale Factor Test	X	X			X							
6.2.16	IMU Performance Test	X	X			X						X	
6.2.17	Fine Alignment Test	X	X	X	X					X	X		
6.2.19	Voltage Margin Test				X					X	X		
6.2.7	Gimbal Friction Test	X	X						X		X		
6.2.18	Gyrocompassing Test**	X	X			X						X	
6.2.4	G&N Power Supplies Test		X		X	X			X	X	X	X	
6.2.21	S/C Control & Display Test				X					X	X		

* To be used as necessary to turn system on and off.

** If gyrocompass test is performed as part of a retest activity, it shall be performed for a total of 5 hours including the 2 hour settling period.

5.8 The following conditions are required for testing the G&N System.

5.8.1 Spacecraft systems other than the G&N System may be operating on a noninterfering basis while individual system checkout of the G&N System is being conducted.

5.8.2 The G&N System shall be supported by the Electrical Power System and Environmental Control System during operation in the Command Module. The Stabilization and Control System shall be connected to the G&N System during G&N operation in the Command Module for passive loading purposes if available.

5.8.3 During tests which interface with the Stabilization and Control System and the Central Timing System, operation of these systems shall be required.

5.9 The G&N System shall be tested per this specification after it is installed in the spacecraft. In the event that the installed system, or any assembly thereof, is removed from the spacecraft for modification, recycle, or any other reason, this process specification or pertinent portions of it shall be performed after the G&N System or assembly thereof, is reinstalled. Testing shall be limited to G&N System operation while actively connected to qualified spacecraft threshold systems, namely, the Electrical Power System (EPS), Environmental Control System (ECS), and Communication and Instrumentation System (C&IS) as much as possible. However, a minimum of combined and integrated system testing with the Stabilization and Control System (SCS). Central Timing System (CTS) and Caution and Warning System is required for complete G&N System verification.

5.10 The test equipment listed in paragraph 4.1 shall be connected and ready for operation before the tests of this specification are initiated.

5.11 **Data Records**

5.11.1 All data concerning the checkout and operation of the G&N System as monitored via ACE, shall be recorded on the data sheets associated with their corresponding test. Out of tolerance readings shall be recorded and flagged by appropriate symbols.

5.11.1.1 All test data obtained while demonstrating the requirements of this document shall be permanently recorded and forwarded to the next receiving agency.

5.11.1.2 A record of the amount of time each of the four prime power busses are on shall be kept and forwarded to the next receiving agency.

5.12 **Interface**

5.12.1 The APOLLO G&N System shall interface with accepted ECS and EPS distribution systems for power and environment control purposes and with the SCS or SCS substitute system for signal interface in accordance with the applicable IDC's.

6.0 DETAIL REQUIREMENTS

6.1 Initial Test Conditions

6.1.1 The following precautions shall be observed to preclude loss of continuity in inertial component performance history of the IMU. Deviation may necessitate recalibration of the inertial components.

6.1.1.1 The IMU shall be supplied with heater power on a continuous basis. When S/C Ground Power Supply, Model No. C14-418 is not providing heater power, then heater power shall be supplied through the Inertial Components Temperature Controller (ICTC) Model No. 513-100. The temperature of the IRIG's shall be maintained between 120° and 150°F. The temperature of the PIPA's shall be maintained between 115° and 145°F.

6.1.1.2 The Standby Mode is identified by the circuit breakers IMU HTR MN A, IMU HTR MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on LEB Lighting Control Panel in the OFF position. The Operate Mode is identified by the circuit breaker IMU HTR MNA, MN B, COMPUTER MN A and MN B in the ON position and IMU MN A and MN B and the G&N Power-IMU switch on the LEB Lighting Control Panel in the ON position. The G&N System shall be operating in the Standby Mode with CMC power ON for a minimum of two hours prior to advancing to the IMU Operate Mode. In the event Standby or CMC power is interrupted, an equivalent time period shall be allowed when power is restored before advancing to the Operate Mode, except that when the interval of interruption exceeds two hours, a two-hour warmup period shall be mandatory (exceptions to the 2-hour warmup are noted in 6.2.5.2).

6.1.1.3 The Inertial Measurement Unit shall not be without heater power for more than 15 minutes.

6.1.1.4 During the turn on of the G&N power, COMPUTER MN A and MN B and IMU HTR MN A and IMU HTR MN B circuit breakers must be turned on before the IMU MN A and IMU MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. During the turn off of the G&N power the IMU MN A and IMU MN B circuit breakers must be turned off before the IMU HTR MN A and IMU HTR MN B circuit breakers on the Right Hand Circuit Breaker Panel of the CM. In no case shall COMPUTER MN A and MN B circuit breaker be turned off before IMU MN A and MN B circuit breakers.

6.1.1.5 A warmup period of 1 hour with OPERATE power applied shall be required prior to performing any test in which gyro and accelerometer parameters are measured, and 15 minutes warmup prior to any test in which precision amplitude and frequency power supply checks are made.

6.1.1.6 The following Command Module switches shall be in the position shown unless specifically directed otherwise in a procedural function.

a. UP TLM switches on the LEB G&N Control Panel and MDC Panel 2 shall be set to ACCEPT.
b. LAUNCH VEHICLE - GUIDANCE switch on MDC Panel 2 shall be set to IU.
c. The SC CONT switch on MDC Panel 1 shall be set to CMC.
d. The CMC MODE switch on MDC Panel 1 shall be set to AUTO.
e. The V CG switch on MDC Panel 1 shall be set to CSM.
f. The TRACKER switch on G&N Indicator Control Panel shall be set to OFF.
g. The LIGHTS-INTEGRAL control on the LEB Lighting Control Panel and the Left Hand Circuit Breaker panel shall be set to the minimum brightness - OFF position.

6.1.2 The following optical reference alignment requirements shall be demonstrated.

6.1.2.1 G&N Installation Qualification Fixture

6.1.2.1.1 The SXT Optical Reference No. 1 (Azimuth Autoset) LOS shall be located approximately 40 degrees (CW when viewed from above) from the SCZ axis measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT ST LOS.

6.1.2.1.2 The SXT Optical Reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ±30 minutes of arc.

6.1.2.1.3 The SXT Optical Reference No. 2 LOS shall be located approximately 80 degrees from the SXT Optical Reference No. 1 (40 degrees from S/C Z axis) measured in a horizontal plane. At this position, the Optical Reference shall be capable of being viewed through the SXT STAR LOS.

6.1.2.1.3.1 The SXT optical reference LOS position with respect to the horizontal plane shall be known to within 5 arc-seconds. The azimuth bearing of the Optical Reference LOS shall be known to within ± 30 minutes of arc.

6.1.2.1.4 SXT Optical Reference No. 3 shall be capable of being viewed through the SXT LLOS and the STAR LOS simultaneously at the Zero Optics position.

6.1.2.1.4.1 SXT Optical Reference No. 3 shall have the capability to measure the nonparallelism of the LLOS and STAR LOS to a resolution of 2 arc-seconds.

6.1.3 **Prepower Application Requirements**

6.1.3.1 Prior to connecting G&N power connectors 56P30 and 56P31 to spacecraft power connectors C03W1J345 and C03W1J346, respectively, it is necessary to perform a complete verification of spacecraft power. Verification shall be performed with the installation of the G&N System complete except for connection of 56P30 and 56P31 to the S/C connectors.

6.1.3.2 Resistance Check on S/C Power Connectors.

6.1.3.2.1 Insure that the following switches and circuit breakers are set to the position indicated.

a. GUIDANCE/NAVIGATION POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).

b. GUIDANCE/NAVIGATION IMU MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).

c. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).

d. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).

e. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers on the Right Hand Circuit Breaker Panel to OFF (breakers pulled out).

f. G/N POWER switch on the Right Hand Circuit Breaker Panel to OFF.

g. G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

h. G/N POWER - IMU Switch on the LEB Lighting Control Panel to OFF.

6.1.3.2.2 Obtain GSE tool consisting of connectors, extension cables, and connector terminal test box. Mate connectors P1 and P2 of the extension cables with S/C power connectors C03W1J345 and C03W1J346 respectively. Using a VTVOM measure the resistance between the terminals listed in Table I. Resistance measurements shall be as specified in Table I.

TABLE I. RESISTANCE REQUIREMENTS FOR S/C POWER CONNECTORS

Test No.	From	To	Requirements
1	P1-2	P2-18	Open
2	P1-5	↓	↓
3	P1-6		
4	P1-7		
5	P1-8		
6	P1-9		
7	P1-10		
8	P1-11		
9	P1-12		
10	P1-13		
11	P1-14		
12	P1-17		
13	P2-2		
14	P2-5		
15	P2-6		
16	P2-7		
17	P2-8		
18	P2-9		
19	P2-10		
20	P2-11		
21	P2-12		
22	P2-13		
23	P2-14		
24	P2-17		
25	P1-1	P1-18	Continuity
26	P1-3	↓	↓
27	P1-4		
28	P1-15		
29	P1-16		
30	P2-1		
31	P2-3		
32	P2-4		
33	P2-15		
34	P2-16		

6.1.3.3 Polarity and Voltage Check on S/C Power

6.1.3.3.1 Perform a voltage and polarity check of the G&N S/C power by performing the measurements indicated in Table II. Set the following switches to the position indicated.

a. G/N POWER-OPTICS switch on the LEB Lighting Control Panel to ON.

b. G/N POWER - IMU switch on the LEB Lighting Control Panel to ON.

c. G/N POWER switch on the Right Hand Circuit Breaker Panel to AC1.

For each measurement in Table II set the indicated circuit breaker on the Right Hand Circuit Breaker Panel to ON (breaker pushed in). After each measurement return the cirucit breaker to OFF (breaker pulled out).

TABLE II. POLARITY & VOLTAGE REQUIREMENTS FOR S/C POWER

Test No.	Circuit Breaker	Polarity & Connector Pin No.		Requirements
		Low	High	
1	COMPUTER MN A	P1-1	P1-2	+28.8 ± 3 VDC
2	OPTICS MN A	P1-14	P1-7	+28.8 ± 3 VDC
3	IMU MN A	P1-15	P1-9	+28.8 ± 3 VDC
		P1-16	P1-10	+28.8 ± 3 VDC
4	IMU HTR MN A	P1-3	P1-8	+28.8 ± 3 VDC
5	COMPUTER MN B	P2-1	P2-2	+28.8 ± 3 VDC
6	OPTICS MN B	P2-14	P2-7	+28.8 ± 3 VDC
7	IMU MN B	P2-15	P2-9	+28.8 ± 3 VDC
		P2-16	P2-10	+28.8 ± 3 VDC
8	IMU HTR MN B	P2-3	P2-8	+28.8 ± 3 VDC
9	POWER AC 1	P1-18	P1-17	115 ± 10 VAC 400 ± 7 cps
	Set G/N POWER switch on the Right Hand Circuit Breaker Panel to AC 2.			
10	POWER AC 2	P1-18	P1-17	115 ± 10 VAC 400 ± 7 cps

6.1.3.3.2 Verify all circuit breakers exercised in Table II are in the OFF position (breakers pulled out). Set the following switches to the OFF position.

a. G/N POWER - OPTICS switch on the LEB Lighting Control Panel.

b. G/N POWER - IMU switch on the LEB Lighting Control Panel.

c. G/N POWER switch on the Right Hand Circuit Breaker Panel.

6.1.3.3.3 Disconnect connectors P1 and P2 of the test cables from S/C connectors C03W1J345 and C03W1J346, respectively.

6.1.3.4 Resistance Check on G&N Power Connectors.

6.1.3.4.1 Connect test cable connectors J1 and J2 to G&N connectors 56P30 and 56P31, respectively. Using a VTVOM, measure the resistance between the terminals listed in Table II. The measurements shall meet the requirements listed in Table III.

TABLE III RESISTANCE REQUIREMENTS FOR G&N POWER CONNECTORS

Test No.	From	To	Requirements (ohms)	Results
1	J1-15	J1-6	1000 to infinity	
2	J1-15	J1-14	1000 to infinity	
3	J1-15	J1-1	1000 to infinity	
4	J1-15	J1-18	5 meg to infinity	
5	J1-15	J1-16	0.0 to 0.5	
6	J1-15	J1-3	0.0 to 0.5	
7	J1-15	J2-15	0.0 to 0.5	
8	J1-14	J2-14	0.0 to 0.5	
9	J1-1	J2-1	0.0 to 0.5	
10	J1-6	J2-6	0.0 to 0.5	
11	J1-16	J2-16	0.0 to 0.5	
12	J1-3	J2-3	0.0 to 0.5	
13	J1-14	J1-6	1000 to infinity	
14	J1-1	J1-14	1000 to infinity	
15	J1-1	J1-6	0.0 to 2.0 infinity	
16	J1-18	J1-6	5 meg to infinity	
17	J1-18	J1-14	5 meg to infinity	
18	J1-18	J1-1	5 meg to infinity	
19	J1-2	J1-1	2.8 to infinity	
20	J1-9	J1-15	1.1 to infinity	
21	J1-10	J1-16	1.1 to infinity	
22	J1-7	J1-14	2.8 to infinity	
23	J1-8	J1-3	3.7 to infinity	
24	J1-17	J1-18	5 to 20	
25	J2-2	J2-1	2.8 to infinity	
26	J2-9	J2-15	1.1 to infinity	
27	J2-10	J2-16	1.1 to infinity	
28	J2-7	J2-14	2.8 to infinity	
29	J2-8	J2-3	3.7 to infinity	

6.1.3.5 Disconnect the test cable connectors J1 and J2 from G&N power connectors 56P30 and 56P31, respectively. Mate G&N connector 56P30 to S/C connector C03W1J345 and mate G&N connector 56P31 to S/C connector C03W1J346. Mate G&N connector 56P32 to S/C connector C03W1J347.

6.1.4 Emergency Shutdown Procedure

CAUTION: In the event of a malfunction occurence which could damage the G&N System before the normal shutdown procedure 6.2.5 could be performed, the following sequence should be utilized in the spacecraft.

6.1.4.1 On the LEB Lighting Control Panel set the G/N POWER-IMU and G/N POWER - OPTICS switches to OFF.

6.1.4.2 On the Right Hand Circuit Breaker Panel set the following switches and circuit breakers to OFF (breakers pulled out).

a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B

b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B

c. G/N POWER switch to OFF

d. GUIDANCE/NAVIGATION IMU MN A and MN B

e. GUIDANCE/NAVIGATION OPTICS MN A and MN B

f. GUIDANCE/NAVIGATION POWER AC 1 and AC 2

6.1.4.3 Verify that the ICTC is providing heater power to the G&N System.

6.2 **Test Procedures**

6.2.1 Application of Standby Power to G & N System

6.2.1.1 All power and control switches on the G&N Indicator Control Panel shall be placed in the OFF or neutral position.

6.2.1.2 The Inertial Component Temperature Controller (ICTC), shall be supplying inertial component heater power to the G&N System through the PSA, Connector No. 45J2.

6.2.1.3 Computer Power On

6.2.1.3.1 Set G&N COMPUTER MN A and MN B Breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in).

6.2.1.3.2 Set the POWER-AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in), and position G/N POWER switch to AC1.

6.2.1.3.3 Set the computer numerical display lights to the minimum acceptable brightness by rotating the BRIGHTNESS Controls on the MDC and LEB Lighting Control Panels.

6.2.1.3.4 The CMC +28 VDC power discrete shall be issued (CG 1523). This can be observed by the lighted CMC +28 VDC operate lamp on the Event Module. The +28 VDC CMC OPERATE voltage (CG 1520) shall be +28.8 ± 3 VDC. Verify CRT indication.

6.2.1.3.5 Using DSKY, enter VERB 36, ENTR, then press RESET. All computer alarms on the Main Display Console (MDC), LEB CMC DSKY and CRT shall clear.

6.2.1.3.6 The voltage output of the +4 VDC CMC supply shall be +4.00 ± 0.20 VDC, (CG 1030). The value on the CRT shall be recorded.

6.2.1.3.7 The voltage output of the +14 VDC CMC supply shall be +14.0 ± 0.4 VDC, (CG 1020). The value on the CRT shall be recorded.

[illegible] V[illegible] [illegible] indicator on, and [illegible] on the [illegible] and [illegible].

6.2.1.3.8 Zero the CMC erasable memory by entering the following sequence into the K-start:

a. VERB 57, ENTER

b. 00015, ENTER

6.2.1.3.9 Initiate CMC self-check by entering the following sequence into the K-start:

a. VERB 21 NOUN 27, ENTER

b. 77777, ENTER

c. VERB 05 NOUN 01, ENTER

d. 1366, ENTER

6.2.1.3.9 .1 Monitor DSKY until R3 (SCOUNT +2) increments **twice.** If an error is detected, the following will be displayed:

R1 = 01102 or 41102

R2 = XXXXX c (sFail)

R3 = XXXXX c (ERcount)

6.2.1.3.9 .2 Enter the following into the K-start:

a. VERB 21

b. NOUN 27, press ENTER pushbutton

c. 00000, press ENTER pushbutton

6.2.1.4 IMU HTR Heater Power On

6.2.1.4.1 Enter the IMU Standby Mode of operation by engaging the IMU HTR MN A and MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).

6.2.1.4.2 Verify that the IMU +28 VDC STANDBY discrete lamp on Event Module is illuminated (CG 1513).

6.2.1.4.3 Record the value of the following signals displayed on the CRT.

	Signal	Requirement
a.	CG 1331 28V 3200 CPS POWER SUPPLY FEEDBACK	28.6 ± 0.6 VRMS
b.	CG 1510 + 28 VDC STANDBY POWER	28.8 ± 3 VDC

6.2.1.4.4 The PIPA TEMP on the CRT shall be monitored at 15 min., 1 hr. and 2 hrs. from execution of 6.2.1.4.1 to insure that the PIPA Temperature Control Loop circuitry is operating to maintain a temperature of 130.5 ± 1.5F (CG 2300).

6.2.1.4.5 At the termination of the 2-hour period, record the PIPA Temperature (CG 2300) on the CRT.

6.2.2 CMC Operational Test

NOTE: Verify that IMU STANDBY power (including CMC operate power) is applied, IMU OPERATE Power is not applied. (G&N IMU HTR MN A and MN B breakers engaged, Computer MN A and MN B breakers engaged, IMU MN A and MN B breakers disengaged, G/N Power-IMU switch on LEB Lighting Control Panel in OFF Position).

6.2.2.1 Using the LEB CMC DSKY, enter the following sequence of data into the CMC to initiate the DSKY check. Press the ENTER pushbutton after each entry (denoted by E).

VERB 36, E Press RESET

VERB 21 NOUN 27, E

77766, E

6.2.2.2 DSKY check shall check all the electroluminescent elements by displaying the decimal numbers from nine through zero in succession, each set of numbers shall be displayed for approximately 5 seconds. Verify all elements operable on MDC and LEB CMC DSKY's. VERB-NOUN display shall flash.

6.2.2.2.1 Minus and plus signs shall be displayed. Verify operation on MDC and LEB DSKY's.

6.2.2.2.2 COMP ACTY lamp shall be illuminated for approximately 5 seconds, then DSKY shall blank.

6.2.2.3 CAUTION and STATUS Displays

6.2.2.3.1 Enter VERB 35, ENTR, into LEB CMC DSKY.

6.2.2.3.2 The following MDC and LEB CMC DSKY displays shall illuminate for approximately 5 seconds.

a. UPLINK ACTY
b. NO ATT
c. STBY
d. KEY REL Flashing
e. TEMP
f. GIMBAL LOCK
g. PROG
h. RESTART
i. TRACKER
j. OPR ERROR Flashing
k. COMP ACTY
l. VERB-NOUN Flashing
m. Plus 88888 in R1, R2, and R3
n. PGNCS, CMC, ISS Warning lights (CMC shall remain illuminated for approximately 60 seconds.

After indications a through l go out +88888 shall remain in R1, R2, R3.

6.2.2.4 **DSKY Pushbutton Check**

6.2.2.4.1 Enter the following sequence into the LEB CMC DSKY. Press the ENTER pushbutton after each entry (denoted by E).

a. VERB 25 NOUN 01, E
b. 01600, E
c. +00123, E
d. -00456, E
e. -00789, E

6.2.2.4.2 The LEB CMC DSKY shall indicate +00123 in R1, -00456 in R2, and -00789 in R3.

6.2.2.4.3 Enter VERB 05, NOUN 01 into the LEB CMC DSKY. Press the ENTER pushbutton.

6.2.2.4.4 Enter 01600 into LEB CMC DSKY. Press the ENTER Pushbutton. The LEB CMC DSKY shall indicate 00024 in R1, 77664 in R2, and 77576 in R3. Verify.

6.2.2.4.5 Repeat of 6.2.2.4.1 through 6.2.2.4.4 using the MDC CMC DSKY. The results shall be as specified in 6.2.2.4.4.

6.2.2.5 Uplink and Downlink Checks.

6.2.2.5.1 Enter VERB 36 into K148. Press the ENTER pushbutton, then press ERROR RESET pushbutton.

6.2.2.5.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

a. VERB 25 NOUN 01 ENTER
b. 01600, ENTER
c. 00000, ENTER
d. 77777, ENTER
e. 07254, ENTER
f. VERB 05 NOUN 01, ENTER
g. 01600, ENTER

6.2.2.5.3 CMC Registers R1, R2, and R3 display on the CRT shall indicate 00000, 77777, and 07254, respectively.

6.2.2.6 CMC Automatic Self-Test

6.2.2.6.1 Initiate the CMC Automatic Self-Test by entering the following sequence into K148. Press the ENTER pushbutton after each entry.

a. VERB 21, NOUN 27, ENTER
b. 77777, ENTER
c. VERB 15 NOUN 01, ENTER
d. 1366, ENTER

6.2.2.6.2 Monitor DSKY until R3 (SCOUNT +2) increments twice. If an error is detected, the following will be displayed:

VERB 05 NOUN 31
R1 = 01102 or 41102
R2 = XXXXX c (S Fail)
R3 = XXXXX c (ERcount)

6.2.2.6.3 Enter the following into the K-start:

a. VERB 21 NOUN 27, press ENTER pushbutton

b. 00000, press ENTER Pushbutton

6.2.2.7 Parity Fail Test

6.2.2.7.1 Enter the following into the K-Start. Press the ENTER pushbutton after each entry.

a. VERB 57, ENTER

b. 00015, ENTER

c. VERB 21 NOUN 02, ENTER

d. 01600, ENTER

e. 33777, ENTER

f. VERB 25 NOUN 26, ENTER

g. 04000, ENTER

h. 01600, ENTER

i. 00003, ENTER

j. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.7.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.7.3 Enter VERB 36, into the K-START. Press the ENTER pushbutton.

6.2.2.8 Rupt Lock Test

6.2.2.8.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

a. VERB 24 NOUN 01, ENTER
b. 01600, ENTER
c. 30901, ENTER
d. 01600, ENTER
e. VERB 25 NOUN 26, ENTER
f. 00001, ENTER
g. 01600, ENTER
h. 00003, ENTER
i. VERB 31, ENTER

The RESTART lamps on the MDC and LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.8.2 Press the ERROR RESET pushbutton on the K-START. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.8.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.2.9 TC Trap Test

6.2.2.9.1 Enter the following sequence into the K-Start. Press the ENTER pushbutton after each entry.

a. VERB 21 NOUN 02, ENTER
b. 01600, ENTER
c. 01600, ENTER
d. VERB 25 NOUN 26, ENTER
e. 04000, ENTER
f. 01600, ENTER
g. 00003, ENTER
h. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on the MDC and LEB CMC DSKY's and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.9.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.9.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.2.10 Nightwatchman Test

6.2.2.10.1 Enter the following sequence into the K-Start. Press ENTER pushbutton after each entry.

a. VERB 24 NOUN 01, ENTER
b. 01600, ENTER
c. 30001, ENTER
d. 01600, ENTER
e. VERB 25 NOUN 26, ENTER
f. 04000, ENTER
g. 01600, ENTER
h. 00003, ENTER
i. VERB 30, ENTER

The RESTART lamps on the MDC & LEB DSKY's shall illuminate. The PGNS caution lamps on the MDC & LEB annunciator panels shall illuminate. VERB 05 and NOUN 31 shall be displayed on MDC and LEB CMC DSKY and ROWS 1, 2, and 3 shall indicate 00000.

6.2.2.10.2 Press the ERROR RESET pushbutton on the K-Start. The RESTART & PGNS caution lamps shall extinguish.

6.2.2.10.3 Enter VERB 36 into the K-Start. Press the ENTER pushbutton.

6.2.2.11 Bank Sum Check

6.2.2.11.1 From a program listing for the installed CMC ropes, obtain a list of bank CKSM bugger words.

6.2.2.11.2 Enter VERB 56, ENTER into K148.

6.2.2.11.3 Record the following:

R1 = Bank Sum
R2 = Bank Number
R3 = Bank CKSM bugger word

R1 shall be the same or the complement of R2.
R3 shall equal the CKSM bugger word for the indicated bank.
Enter VERB 33, ENTER

6.2.2.11.4 Repeat 6.2.2.11.3 until all banks have been checked. Terminate the Bank Sum Test by entering VERB 34, ENTER into K148.

6.2.2.12 CMC Clock Frequency Test

6.2.2.12.1 Insure that the CMC has been operating for at least 15 min. before performing this test.

6.2.2.12.2 Insure that the IMU 3.2 kc 28 V Supply is available on the vertical input to PIPA Scope.

6.2.2.12.3 Insure that the EPUT Meter and preset counter plug-in unit are connected to 115V, 60 cps power.

6.2.2.12.3.1 Permit the EPUT to warm up for the length of time required by the manufacturer's specification.

6.2.2.12.4 Connect the signal output from Oscilloscope 4A4-A1 to the input channel on the EPUT Meter.

6.2.2.12.5 Set the preset counter to indicate 96000.

6.2.2.12.6 Set the EPUT meter to count at the maximum count rate (1 megacycle or greater).

6.2.2.12.7 Adjust the Trigger Level to the point midway between the range over which the counter will normally count.

6.2.2.12.8 Each count cycle shall last approximately 30 seconds. Adjust the display time to permit recording the display on the EPUT.

6.2.2.12.9 Record the results of 10 count-cycles. Calculate the average time per cycle over the 10 cycles. Record the result.

6.2.2.12.10 Divide 96000 by the average time from 6.2.2.11.9. Record the result as 3200 cps frequency.

6.2.2.12.11 Multiply the 3200 cps frequency by 640. Record the results as the CMC clock frequency.

6.2.2.12.11.1 The CMC Clock Frequency shall be 2048000 ± 5 cps.

6.2.3 Operate Power On Test

6.2.3.1 IMU Operate Power ON

CAUTION: The sequences specified in this test must be adhered to. Deviations may necessitate recalibration of the inertial components.

NOTE: Disregard the GIMBAL LOCK indicator until the completion of step 6.2.3.1.6.

6.2.3.1.1 The following Command Module switches and circuit breakers shall be in the following state:

Right Hand Circuit Breaker Panel

a. GUIDANCE/NAVIGATION COMPUTER MN A and MN B breakers on (pushed in)
b. GUIDANCE/NAVIGATION IMU HTR MN A and MN B breakers on (pushed in)
c. GUIDANCE/NAVIGATION IMU MN A and MN B breakers off (pulled out)
d. GUIDANCE/NAVIGATION OPTICS MN A and MN B breakers off (pulled out)

LEB Lighting Control Panel

e. G/N Power - IMU set to OFF
f. G/N Power - Optics set to OFF

6.2.3.1.2 Switches and selectors on the G&N Indicator control panel shall be set as follows:

a. OPTICS MODE to MANUAL
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to MED
d. TELESCOPE TRUNNION to SLAVE to SXT
e. RETICLE BRIGHTNESS to minimum brightness position

6.2.3.1.3 Adjust the Command Module MDC and LEB Lighting Controls to minimum intensity for proper readout of G&N Displays.

6.2.3.1.4 Set up the ACE analog recorders to monitor the following measurements (set chart speed to 5 mm/sec):

a. CG 2117 IGA Servo Error In Phase
b. CG 2177 OGA Servo Error In Phase
c. CG 2147 MGA Servo Error In Phase
d. CG 2112 IG IX Resolver Output Sin
e. CG 2172 OG IX Resolver Output Sin
f. CG 2142 MG IX Resolver Output Sin
g. CG 1040 +120 VDC PIPA Supply DC Level

CAUTION: Before proceeding, insure that the G&N System has been operating in the STANDBY MODE (power configuration as defined in 6.2.3.1) for a minimum period of 2 hours. Exceptions to this requirement are noted in 6.2.5.2.9.

CAUTION NOTE: If the requirements of 6.2.3.1.6 are not met, remove IMU operate power immediately by placing the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.3.1.5 Perform the following sequence:

a. Turn on the IMU MNA and MN B circuit breakers on the Right Hand Circuit Breaker Panel (breakers pushed in).
b. Start Analog Recorders.
c. Place G/N Power - IMU switch on the LEB Lighting Control Panel to IMU (switch toggle up).

6.2.3.1.6 Immediately begin monitoring the following measurements.

a. The IMU Operate Power is +28.8 ± 3VDC (CG 1500). Verify on CRT.
b. On the recorders, verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application in 6.2.3.1.5 on the following measurements:

   CG 2112, IG IX Resolver Output Sin
   CG 2142, MG IX Resolver Output Sin
   CG 2172, OG IX Resolver Output Sin

c. On the CRT, verify the absence of the +120 VDC PIPA supply (CG 1040) for a period of 90 ± 10 seconds following power application in 6.2.3.1.5. After approximately 100 seconds, the voltage shall read +120 ± 6 VDC.

6.2.3.1.7 Insure that the following alarm lamps are not lighted on G&N LEB Display Panel.

a. CMC Warning
b. ISS Warning
c. PGNS Caution

6.2.3.1.8 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.3.1.9 The OG, IG, and MG CDU angles shall be 00000 ± 00150. Verify on CRT.

6.2.3.1.10 Verify that the following secondary power supply voltages are not flashing on the CRT display.

TABLE VI. SECONDARY POWER SUPPLY VOLTAGES

Meas. No.		Signal
1	CG 1040	+120 VDC PIPA SUPPLY
2	CG 1051	+20 VDC PIPA SUPPLY
3	CG 1052	-20 VDC PIPA SUPPLY
4	CG 1070	+4 VDC CDU SUPPLY
5	CG 1100	-28 VDC ELECTRONICS
6	CG 1020	+14 VDC CMC SUPPLY
7	CG 1030	+4 VDC CMC SUPPLY
8	CG 1201	IMU 28 V 800 CPS 1 pct 0 ph
9	CG 1202	IMU 28 V 800 CPS 5 pct ph A
10	CG 1203	IMU 28 V 800 CPS 5 pct ph B
11	CG 1331	3.2KC 28 V SUPPLY
12	CG 1110	2.5 VDC TM BIAS

6.2.3.2 Optics Power ON

6.2.3.2.1 Optics power shall be applied by actuating the G&N OPTICS MN A and OPTICS MN B breakers on the Right Hand Circuit Breaker Panel (breakers pushed in), and placing G/N Power - OPTICS switch on the LEB Lighting Control Panel to ON.

6.2.3.2.2 OPTICS +28 VDC discrete shall be issued (CG 1533). Verify by observing that the OPTICS lamp on Event Module is illuminated. Verify that the +28 VDC OPTX OPERATE BUS (CG 1530) is +28.8 ± 3 VDC. Record the indication on the CRT.

6.2.3.2.3 Verify the following secondary power supply voltages on the CRT are not flashing:

CG 1211	OPTX 28 V 800 CPS 1 pct 0 ph
CG 1212	OPTX 800 CPS 5 pct-90ph

6.2.3.3 Enter and verify VERB 40 NOUN 20 into K148. Press the ENTER pushbutton to advance the system to the Zero CDU mode.

6.2.3.4 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the system to Coarse Align under CMC control. The VERB NOUN display on CRT shall flash and indicate 21-22.

6.2.3.5 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton after each entry.

6.2.4 G&N System Power Supplies Test

6.2.4.1 Proceed with this test if 6.2.3, Operate Power On Test, has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding with this test. Insure that the IMU Operate Power has been on for at least 15 minutes before proceeding with this test.

6.2.4.2 Enter the following sequence into the K-Start. Verb 41 NOUN 20, ENTER; +00000 ENTER; +00000 ENTER; +00000 ENTER.

6.2.4.3 Insure that OPERATE power has been applied for at least 15 minutes. Verify that the discretes listed below have been issued by noting that the event lamps on the specified Event Module are illuminated.

a. IMU STANDBY POWER (CG 1513)

b. CMC OPERATE POWER (CG 1523)

c. OPTX OPERATE POWER (CG 1533)

6.2.4.4 The IRIG and PIPA Pulse Torque DC supply shall demonstrate the following requirements. The DC output voltages shall be as follows. Record the indicated voltages on the CRT.

a. The 120 volt PIPA Power Supply output voltage shall be 120 ± 6 VDC (CG 1040).

b. The PIPA +20 VDC Supply output voltage shall be +20 ± 1.2 VDC (CG 1051).

c. The PIPA -20 VDC output voltage shall be -20 ± 2 VDC (CG 1052).

6.2.4.5 The minus 28 VDC Electronics Power Supply output voltage shall be -27.5 ± 6.0 VDC (CG 1100). Record the indicated voltage displayed on the CRT.

6.2.4.6 Power Supplies

Record the indicated voltage display on the CRT.

a. The +14 VDC CMC Power output voltage shall be +14.0 ± 0.4 VDC (CG 1020).

b. The +4 VDC CMC Power Supply output voltage shall be +4.00 ± 0.20 VDC (CG 1030).

c. The +4 VDC CDU Power Supply output voltage shall be ± 4.0 ± 0.2 VDC.

d. The +2.50 VDC TM BIAS SUPPLY output voltage shall be +2.50 ± 0.05 VDC (CG 1110).

6.2.4.7 Twenty-eight volt, 800 cps Power Supplies - the following values shall be measured with the guidance reference clock synchronizing input pulses. Record the indicated voltage displayed on the CRT.

a. IMU +28 V, 800 CPS 1 per cent 0 degree voltage shall be +28.0 ± 0.6 VAC (CG 1201).

b. IMU 28 V, 800 CPS, 5 percent PH A -90 degree voltage shall be 28.0 ± 1.4 VAC (CG 1202).

c. IMU +28 V, 800 CPS 5 per cent Ph B 0 degree voltage shall be 28.0 ± 2.1 VAC (CG 1203).

d. Optics +28 V, 800 CPS 1 per cent 0 degree voltage shall be 28.0 ± 0.6 VAC (CG 1211).

e. Optics +28 V, 800 CPS 5 per cent -90 degree voltage shall be 28.0 ± 1.5 VAC (CG 1212).

6.2.4.8 IMU 3200 CPS Supply

The 28 V 3200 CPS Supply feedback output voltage shall be 28.6 ± 0.6 volts RMS (CG 1331). Record the indicated voltage displayed on the CRT.

6.2.4.9 Plus 28 VDC Busses

Record the indicated voltage displayed on the CRT.

a. The +28 VDC IMU OPERATE (Buss No. 1) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1500).

b. The +28 VDC IMU STANDBY (Buss No. 2) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1510).

c. The +28 VDC IMU STANDBY (Buss No. 3) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1520).

d. The +28 VDC OPTX OPERATE (Buss No. 4) output voltage shall be 28.8 (+3, -3) VDC under normal system load (CG 1530).

6.2.4.10 Noise

a. The +14 VDC CMC Power Supply RMS noise shall be less than 0.4 volt pp (CG 1021).

b. The +4 VDC CMC Power Supply noise peak shall be less than 0.4 volt pp (CG 1031).

6.2.4.11 IMU 1% CMC Sync Phase Difference

The Phase difference between the 3.2 kc supply and CMC sync shall be 0° ± 10° (NG 1336). Record the phase difference as indicated on the CRT.

6.2.4.12 Miscellaneous Checks. - The following miscellaneous signals are required to supply data for system evaluation in event of failure, or for trend analysis of system performance. Record the values of the following signals displayed on the CRT.

a.	CG 4300	CMC Temperature
b.	CG 6020	PIPA Calibration Module Temperature
c.	CG 6021	IMU 800 CPS 5 per cent Temperature

6.2.4.13 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.5 General Turn Off and Turn On Procedure

NOTE: This procedure shall be utilized any time after performing 6.1.3 Prepower Application Requirements, 6.2.1, Standby Power On Test, and 6.2.3. Operate Power on Test, to turn on or turn off the G&N System. Appropriate portions of this procedure will be referenced in other tests.

6.2.5.1 Turn Off Procedure.

CAUTION: This procedure must be performed in the sequence specified. Failure to adhere to this sequence may require calibration of the inertial components.

6.2.5.1.1 Enter the following sequence into the K-148.

a. VERB 41 NOUN 20, ENTER
b. +00000 ENTR
c. +00000 ENTR
d. +09000 ENTR

Verify that the GIMBAL LOCK indicator on the DSKY's is illuminated.

6.2.5.1.2 Set the following switches on the G&N Indicator Control Panel to the positions designated.

a. OPTICS MODE to MANUAL
b. CONTROLLER MODE to DIRECT
c. CONTROLLER SPEED to MED
d. TELESCOPE TRUNNION to SLAVE TO SXT
e. RETICLE BRIGHTNESS to minimum brightness position

6.2.5.1.3 Set the G/N Power - IMU switch on the LEB Lighting Control Panel to OFF and G&N IMU MN A and MN B circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.4 Decrease the LIGHTS - NUMERICS controls on both the Left Hand Circuit Breaker panel and the LEB Lighting Control Panel to the minimum brightness - OFF position.

6.2.5.1.5 Set the IMU HTR MN A and MN B circuit breaker on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.6 Set the COMPUTER MN A and MN B Circuit breakers on the Right Hand Circuit Breaker panel to OFF (breakers pulled out).

6.2.5.1.7 Set the G&N Power AC1-OFF-AC2 Switch on the Right Hand Circuit breaker panel to OFF and the G&N POWER AC1 and AC2 circuit breakers to OFF (breakers pulled out).

6.2.5.1.8 Set the G/N POWER - OPTICS switch on the LEB Lighting Control Panel to OFF and G&N OPTICS MN A and MN B breakers on the Right. Hand Circuit breaker panel to OFF.

6.2.5.1.9 Verify that the ICTC is supplying inertial components heater power to the G&N System. This will be indicated by the following on the PTC.

a. G&N ON(PTC inhibit) light not illuminated.

b. IMU Temp/heater current meter indicates IMU temperature of 130°±5°F.

6.2.5.2 Turn ON Procedure

6.2.5.2.1 Set or verify the following G&N Indicator Control Panel switches to the position indicated.

a. CONDITION LAMPS to ON

b. OPTICS MODE to MANUAL

c. CONTROLLER COUPLING to DIRECT

d. CONTROLLER SPEED To DIRECT

e. TELESCOPE TRUNNION to SLAVE to SXT

f. RETICLE BRIGHTNESS to minimum brightness position.

6.2.5.2.2 Insure that interfacing system EPS and ECS are turned on and operating properly.

CAUTION: The remaining procedure must be followed in sequence specified. Failure to adhere to this sequence may require recalibration of the inertial components.

6.2.5.2.3 Energize the G&N COMPUTER MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in). If the STBY indicator on the DSKY is illuminated, press the STBY pushbutton for approximately 3 seconds until the STBY indicator extinguishes.. Enter VERB 61 into K148 and press the ENTER pushbutton. Insure that the CMC +28 VDC discrete lamp on the Event Module is illuminated (CG 1523). Verify +14 and +4 VDC AGC power supply outputs on CRT display. Voltages shall be +14 ± 0.4V (CG 1020) and +4 ± 0.2 (CG 1030).

6.2.5.2.4 Set the G&N POWER AC1 and AC2 breakers on the Right Hand Circuit Breaker Panel to ON (breakers pushed in). Set the G&N POWER AC1-OFF-AC2 switch to AC1.

6.2.5.2.4.1 Set the G&N DSKY and Display Panel brightness to the minimum acceptable level by manipulation of LIGHTS - NUMERICS control on both Left Hand Circuit breaker panel and LEB Lighting Control panel.

6.2.5.2.5 Energize the G&N IMU HTR, MN A and MN B breakers on the Right Hand Circuit Breaker panel (breakers pushed in).

6.2.5.2.6 Disregard all alarm indication on the CMC DSKY panels. Enter VERB 36 into K148. Press ENTER pushbutton. Press ERROR RESET pushbuttons on K148. All computer alarms except the Gimbal Lock Indicator on the Main Display Console (MDC) and LEB AGC DSKY shall clear. Verify registers R1, R2, and R3 on the DSKY's are cleared.

6.2.5.2.7 Clear the CMC erasable memory by entering the following sequence into the K-Start.

a. VERB 57, press ENTER

b. 00015, press ENTER

6.2.5.2.8 Initiate CMC self-check by entering the following sequence into the K-Start:

a. VERB 21 NOUN 27, ENTER

b. 77777, ENTER

c. VERB 05 NOUN 01, ENTER

d. 1366, ENTER

6.2.5.2.8.1 Monitor DSKY until R3 (SCOUNT +2) increment twice. If an error is detected, the following will be displayed:

VERB 05 NOUN 31
R1 = 01102 or 41102
R2 = XXXXX c (S Fail)
R3 = XXXXX c (ERcount)

6.2.5.2.8.2 Enter the following into the K-Start:

a. VERB 21

b. NOUN 27 ENTER

c. 00000, ENTER

NOTE: Allow 2 hours to elapse before proceeding to 6.2.5.2.9 with the following exceptions:

a. If the G&N System has been in the power off state for less than 5 days with the gimbals in the parked position (0°, 0', 90°) and the system has not been moved, allow 15 minutes to elapse before proceeding.

b. If the G&N System has been turned off for less than 15 minutes allow 90 seconds to elapse before proceeding.

c. If the G&N System has been turned off with the gimbals in the unparked position for more than 15 minutes but less than 2 hours allow a warmup time equal to the time off to elapse before proceeding.

CAUTION: If the requirements of 6.2.5.2.10 are not met, remove IMU Operate Power immediately by setting the G/N POWER-IMU switch on the LEB Lighting Control Panel to OFF.

6.2.5.2.9 After the required warmup time has elapsed set the G&N IMU MN A and MN B circuit breaker on the Right Hand circuit breaker panel to ON (breaker pushed in), and the G/N POWER - IMU switch on the LEB Lighting Control panel to the IMU position (toggle up).

6.2.5.2.10 Immediately begin monitoring the following measurements.

a. On the CRT verify that IMU Operate Power is +28.8 ± 3 VDC (CG 1500).

b. On the meter modules verify that oscillations are not sustained and that a null is achieved within 10 seconds of power application on the following measurements:

CG 2112	IG 1X Resolver Output Sin
CG 2142	MG 1X Resolver Output Sin
CG 2172	OG 1X Resolver Output Sin

c. On the CRT verify the absence of the +120 VDC PIPA Supply (CG 1040) for a period of 90 ± 10 seconds following power application. After approximately 100 seconds, the voltage shall read +120 ± 6 VDC.

6.2.5.2.11 Verify that the PROGRAM ALARM lamp on the DSKY's does not light with VERB 05 NOUN 31 and R1 = 00213 displayed.

6.2.5.2.12 Enter and verify VERB 40, NOUN 20 into K148. Press the ENTER pushbutton.

6.2.5.2.13 Enter and verify VERB 41, NOUN 20 into K148. Press the ENTER pushbutton to advance the System to the Coarse Align mode. The VERB-NOUN display on the CRT shall flash and indicate 21-22.

6.2.5.2.14 Enter and verify +00000 into K148 three times, pressing the ENTER pushbutton on the K-START after each entry.

6.2.5.2.15 Set the G&N OPTICS MN A and MN B circuit breakers on the Right Hand Circuit breaker panel to the ON position (breaker pushed in).

6.2.5.2.16 Verify that the CRT indications of the signals in Table VI are not flashing.

Table VI. Secondary Power Supply Voltages

Measurement Number	Signal
1 CG 1040	+120 VDC PIPA SUPPLY
2 CG 1051	+20 VDC PIPA SUPPLY
3 CG 1052	-20 VDC PIPA SUPPLY
4 CG 1070	+4 VDC CDU SUPPLY
5 CG 1100	-28 VDC ELECTRONICS
6 CG 1020	+14 VDC CMC SUPPLY
7 CG 1030	+4 VDC CMC SUPPLY
8 CG 1201	IMU 28V 800 CPS 1 pct 0 ph
9 CG 1202	IMU 28V 800 CPS 5 pct ph A
10 CG 1203	IMU 28V 800 CPS 5 pct ph B
11 CG 1331	3.2 KC 28V SUPPLY
12 CG 1110	2.5 VDC TM BIAS
13 CG 2300	PIPA TEMPERATURE
14 CG 2301	IRIG TEMPERATURE

6.2.5.2.17 Monitor the PIPA Display Scope to insure that each PIPA is moding properly.

6.2.5.2.18 Perform 6.2.6 G&N Operational Test.

6.2.5.3 Master Initialization

6.2.5.3.1 Set/verify the following Circuit Breakers and switches.

a. G&N COMPUTER MN A & MNB
b. G&N POWER AC1 & AC2
c. G&N IMU HTR MNA & MNB
d. G/N POWER AC1 - OFF - AC2 switch to AC1

NOTE: If IMU OPERATE POWER is not ON proceed to 6.2.5.2.9.

6.2.5.3.2 Verify that the PIPA Temperature (CG 2300) is 130.0 ± 1.5°F.

NOTE: If the GIMBAL LOCK lamp on the DSKY is lit, proceed to 6.2.5.3.5.

6.2.5.3.3 Enter VERB 36, ENTER into K148.

6.2.5.3.4 Enter VERB 40 NOUN 20, ENTER into K148.

6.2.5.3.5 Enter the following into K148.

a. VERB 41 NOUN 20, ENTR
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

Observe the NO ATT lamp lights and the Inner, Outer, and Middle Gimbal Angles are 0 ± 1.5° as indicated by CDU X, CDU Y, and CDU Z on the CRT.

6.2.5.3.6 Press the ERROR RESET pushbutton. Enter the following into K148.

a. VERB 57, ENTER
b. 00015, ENTER

6.2.6 G&N Operation Test

6.2.6.1 Initial Conditions

6.2.6.1.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.6.1.2 Enter the following into K148.

a. VERB 01 NOUN 10, ENTER
b. 00003, ENTER

Record R1 = AAAAA and Range Time.

6.2.6.1.3 Enter the following into K148.

a. VERB 21 NOUN 02, ENTER
b. 01300, ENTER
c. AAAAA, ENTER
d. VERB 06 NOUN 02, ENTER
e. 01300, ENTER

Record R1 = BBBBB

6.2.6.1.4 Perform the following calculations:

a. $\frac{(BBBBB) \times 5.12}{3600}$ = CC.C (hours in high order scaler channel 3)
b. 23.3 - CC.C = DD.D hours
c. DD.D plus the time of day recorded in 6.2.6.1.2 = the time at which the high order scalar, channel 3, will overflow.

Do not enter the G&N Operational Test within 12 minutes of the time calculated in 6.2.6.1.4.c. If the test is in process at this time, undesirable results will occur.

6.2.6.2 **Test Initiation**

6.2.6.2.1 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.6.2.2 Enter 00004 into K148. Press the ENTER pushbutton.

6.2.6.2.3 Verify that the PROGRAM display on the CRT indicates 07.

NOTE: During this portion of the test the G&N System is exercised through its modes. Any failures will be indicated by the PROGRAM ALARM lamp on the DSKY's lighting with VERB 05 NOUN 31 and R1 = 01411 displayed.

6.2.6.2.4 After approximately 12 minutes, VERB 06, NOUN 66 will flash and the value of the gravity vector in cm/sec^2 shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.5 R1 contains the first five digits of the gravity vector and R2 contains the last five digits. A decimal point shall be between them. The value for the gravity vector shall be 980.00000 ± 05.00000 cm/sec^2.

6.2.6.2.6 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.6.2.7 When VERB 06 NOUN 66 flashes the value of the horizontal earth rate shall be displayed in R1 and R2 on the CRT. Record these values.

6.2.6.2.8 R1 contains the first five digits of earth rate and R2 contains the last five digits. A decimal point shall be placed between them. R1 shall always be 00000. The horizontal earth rate shall be 00000.88000 ± 0.1000 earth rate units.

6.2.6.3 **Test Termination**

6.2.6.3.1 Enter VERB 36 into K148. Press the ENTER pushbutton.

6.2.6.3.2 Enter VERB 41, NOUN 20 into K148. Press the ENTER pusbuttton.

6.2.6.3.3 Enter +00000 into K148 three times. Press the ENTER pushbutton after each entry.

6.2.7 **Gimbal Friction Test**

6.2.7.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.7.2 **Inner Gimbal Friction Test**

6.2.7.2.1 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry:

a. VERB 41 NOUN 20, ENTER
b. +00000, ENTER
c. +00000, ENTER
d. +00000, ENTER

6.2.7.2.2 Sétup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

a.	CG 2120	IG TORQUE MOTOR CURRENT
b.	CG 2117	IGA SERVO ERROR IN PHASE
c.	CG 2112	IG 1X RESOLVER OUTPUT SIN
d.	CG 2113	IG 1X RESOLVER OUTPUT COS
e.	CG 2220	IGA CDU FINE ERROR
f.	CG 1201	IMU 28V 0.8 KC 1 pct 0 Deg
g.	CG 2300	PIPA TEMPERATURE
h.	CG 2301	IRIG TEMPERATURE

6.2.7.2.3 Enter the following sequence into the K-Start, pushing the ENTER pushbutton after each entry (+360 IG torquing).

a. VERB 24 NOUN 01, ENTER
b. 00407, ENTER
c. 40000, ENTER
d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.2.4 Enter the following sequence into K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (verify VERB 33 on CRT)

6.2.7.2.5 Start analog recorders.

6.2.7.2.6 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders. During this period monitor IG TORQUE MOTOR CURRENT (CG 2120) on the CRT.

6.2.7.2.7 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40, NOUN 20, press ENTER
b. VERB 41, NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. +00000, press ENTER

6.2.7.2.8 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding .

6.2.7.2.9 Enter the following sequence into the K-Start. Push the ENTER push button after each entry (-360° IG torquing):

a. VERB 24 NOUN 01 ENTER
b. 00407, ENTER
c. 37777, ENTER
d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.2.10 Enter the following sequence into K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (Verify VERB 33 on CRT).

6.2.7.2.11 Start analog recorders.

6.2.7.2.12 Observe measurement CG 2112, IG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders.

6.2.7.2.13 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40, NOUN 20, press ENTER
b. VERB 41, NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. +00000, press ENTER

6.2.7.2.14 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

6.2.7.3 Outer Gimbal Friction Test.

6.2.7.3.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

a.	CG 2180	OG TORQUE MOTOR CURRENT
b.	CG 2177	OGA SERVO ERROR IN PHASE
c.	CG 2172	OG 1X RESOLVER OUTPUT SIN
d.	CG 2173	OG 1X RESOLVER OUTPUT COS
e.	CG 2280	OGA CDU FINE ERROR
f.	CG 1201	IMU 28V 0.8 KC 1 PCT 0 DEG RMS
g.	CG 2300	PIPA TEMPERATURE C
h.	CG 2301	IRIG TEMPERATURE

6.2.7.3.2 Enter the following sequence into the K-Start. Pushing the ENTER pushbutton after each entry (+360° OG torquing):

a. VERB 24 NOUN 01, ENTER
b. 00405, ENTER
c. 40000, ENTER
d. 40034, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.3 Enter the following sequence into K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (verify VERB 33 on CRT)

6.2.7.3.4 Start analog recorders

6.2.7.3.5 Observe measurement CG 2172, OG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorders. During this period monitor OG TORQUE MOTOR CURRENT (CG 2180) on the CRT.

6.2.7.3.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40, NOUN 20, press ENTER
b. VERB 41, NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. +00000, press ENTER

6.2.7.3.7 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = +00000. Wait 60 seconds before proceeding.

6.2.7.3.8 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (-360° OG torquing):

a. VERB 24 NOUN 01, ENTER

b. 00405, ENTER

c. 37777, ENTER

d. 37743, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.3.9 Enter the following sequence into K-Start:

a. VERB 42, press ENTER

b. VERB 33, press ENTER (verify VERB 33 on CRT).

6.2.7.3.10 Start analog recorders.

6.2.7.3.11 Observe measurement CG 2172, OG 1X resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 12 minutes), stop the recorder.

6.2.7.3.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start:

a. VERB 40, NOUN 20, press ENTER

b. VERB 41, NOUN 20, press ENTER

c. +00000, press ENTER

d. +00000, press ENTER

e. -06750, press ENTER

6.2.7.3.13 Verify on the CRT that R1 = +00000, R2 = +00000, and R3 = -06750, Wait 60 seconds before proceeding.

6.2.7.4 Middle Gimbal Friction Test.

6.2.7.4.1 Setup the ACE Analog Recorders to record the following measurements (use speed of 10 mm/sec):

a.	CG 2150	MG TORQUE MOTOR CURRENT
b.	CG 2147	MGA SERVO ERROR IN PHASE
c.	CG 2142	MG 1X RESOLVER OUTPUT SIN
d.	CG 2143	MG 1X RESOLVER OUTPUT COS
e.	CG 2250	MGA CDU FINE ERROR
f.	CG 2101	IMU 28V, 0.8 KC 1 PCT 0 DEG RMS
g.	CG 2300	PIPA TEMPERATURE
h.	CG 2301	IRIG TEMPFRATURE

6.2.7.4.2 Enter the following sequence into the K-Start. Push the ENTER pushbutton after each entry (+135° MG torquing):

a. VERB 24, NOUN 01, ENTER
b. 00411, ENTER
c. 63777, ENTER
d. 77777, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.3 Enter the following sequence in the K-Start:

a. VERB 42, press ENTER
b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.4 Start the analog recorder.

6.2.7.4.5 Observe measurement CG 2142, MG 1X Resolver output SIN, on the analog recorder. When steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders. During this 5 minute period monitor MG TORQUE MOTOR CURRENT (CG 2150) on the CRT.

6.2.7.4.6 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40 NOUN 01, ENTER
b. VERB 41 NOUN 20, press ENTER
c. +00000, press ENTER
d. +00000, press ENTER
e. +06750, press ENTER

6.2.7.4.8 Enter the following sequence into the K-Start. Push ENTER pushbutton after each entry (-135° MG torquing):

a. VERB 24 NOUN 01, ENTER

b. 00411, ENTER

c. 14000, ENTER

d. 00000, ENTER

Verify on the CRT that (c) appears in R1, (d) appears in R2, and (b) appears in R3.

6.2.7.4.9 Enter the following sequence in the K-Start:

a. VERB 42, press ENTER

b. VERB 33, press ENTER (Verify VERB 33 on CRT)

6.2.7.4.10 Start analog recorders.

6.2.7.4.11 Observe measurement CG 2143, MG 1X Resolver output SIN, on the analog recorder. When the steady-state condition occurs, with the reading near zero (approximately 5 minutes), stop the recorders.

6.2.7.4.12 Return the G&N System to the coarse align mode by entering the following sequence in the K-Start.

a. VERB 40 NOUN 20, press ENTER

b. VERB 41 NOUN 20, press ENTER

c. +00000, press ENTER

d. +00000, press ENTER

e. +00000, press ENTER

6.2.7.5 Examine the traces of the recorded measurements for all six phases of this test to detect any sharp discontinuities. Disregard transients of 0.5 second duration or less on the Gimbal Torque motor current traces, and those less than 0.2 second on the CDU fine error measurement traces. The Gimbal Torque motor currents shall not exceed 0.125 ampere.

6.2.8 G&N Panel Brightness and Lamp Test.

6.2.8.1 Proceed with this test if 6.2.5.2 or 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding with this test.

6.2.8.2 Rotate the RETICLE BIRGHTNESS thumbwheel on the Control Indicator Panel and verify the capability to control the illumination of the following lamps:

a. SCT reticles

b. SXT reticles

c. Telescope Panel Angle Counters

6.2.8.3 Turn on LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.

6.2.8.4 Adjust the brightness controls on the LEB Lighting Control Panel and Left Hand Circuit Breaker Panel from minimum brightness to maximum brightness. Verify the operation of the G&N Indicator Control Panel lamps.

6.2.8.4.1 Re-adjust brightness controls for minimum acceptable lighting. Turn off LIGHTS-INTEGRAL control on Left Hand Circuit Breaker panel and LEB Lighting Control Panel.

6.2.8.5 Push and hold the CONDITION LAMPS switch on the G&N Indicator Control Panel to TEST. Verify the illumination of the following lamps:

a. STAR ACQ

b. MASTER ALARM lamp

6.2.8.6 Set the CONDITION LAMPS switch to ON. Lamps a and b in 6.2.8.5. shall extinguish.

6.2.9 **Semi-Automatic Moding Check**

Proceed with this test if 6.2.2.2.2 or 6.2.4 has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 before proceeding with this test.

6.2.9.1 Test Initiation

6.2.9.1.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify OPTX BUS, 28V 800 ~ 1% and 5% Power Supplies.

6.2.9.1.2 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.9.1.3 Enter 00010 into K148. Press the ENTER pushbutton.

6.2.9.1.4 Observe VERB 06 NOUN 01 flashes on the CRT and the PROGRAM display indicates 07.

6.2.9.2 Enter VERB 33 and press ENTER. After approximately 30 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 02 flashing
b. R1 = +00000 ± 00007
c. R2 = +00000 ± 00007
d. R3 = +00000 ± 00007
e. IG angle = 000 ± 1 deg.
f. MG angle = 000 ± 1 deg.
g. OG angle = 000 ± 1 deg.

6.2.9.3 Enter VERB 33 and press ENTER. After approximately 30 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 03 flashing
b. R1 = +04500 ± 00007
c. R2 = +04500 ± 00007
d. R3 = +04500 ± 00007
e. IG angle = 045 ± 1 deg.
f. MG angle = 045 ± 1 deg.
g. OG angle = 045 ± 1 deg.

6.2.9.4 Enter VERB 33 and press ENTER. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing
b. R1 = 00000 ± 00003
c. R2 = 00000 ± 00003
d. R3 = 00000 ± 00003

NOTE: Negative numbers will be displayed in octal complement form, i.e., -00001 = 77776.

6.2.9.5 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 05 flashing
b. R1 = +07100 ± 00007
c. R2 = +07100 ± 00007
d. R3 = +07100 ± 00007
e. IG angle = 071 ± 1 deg.
f. MG angle = 071 ± 1 deg.
g. OG angle = 071 ± 1 deg.

The GIMBAL LOCK lamps on the DSKY's shall light.

6.2.9.6 Enter VERB 33 and press ENTER. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 06 Flashing
b. R1 = +09000 ± 00007
c. R2 = +09000 ± 00007
d. R3 = +09000± 00007
e. IG angle = 090 ± 1 deg.
f. MG angle = 090 ± 1 deg.
g. OG angle = 090 ± 1 deg.

6.2.9.7 Enter VERB 33 and Press ENTER. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 07
b. R1 =+13500 ± 00007
c. R2 = +13500 ± 00007
d. R3 = +13500 ± 00007
e. IG angle = 135 ± 1 deg.
f. MG angle = 135 ± 1 deg.
g. OG angle = 135 ± 1 deg.

6.2.9.8 Enter VERB 33 and press ENTER. After approximately 20 seconds VERB 06 NOUN 10 shall flash. The GIMBAL LOCK lamp shall extinguish on the DSKY's.

6.2.9.9 Enter VERB 33 and press ENTER. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing.
b. R1 = 00000 ± 00003
c. R2 = 00000 ± 00003
d. R3 = 00000 ± 00003

6.2.9.10 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 12 flashing
b. R1 = +22500 ± 00007
c. R2 = +22500 ± 00007
d. R3 = +22500 ± 00007
e. IG angle = 225 ± 1 deg.
f. OG angle = 225 ± 1 deg.
g. OG angle = 225 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.11 Enter VERB 33 and press ENTER. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 13 flashing
b. R1 = +22500 ± 00007
c. R2 = +22500 ± 00007
d. R3 = +31500 ± 00007
e. IG angle = 225 ± 1 deg.
f. OG angle = 225 ± 1 deg.
g. MG angle = 315 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY shall extinguish.

6.2.9.12 Enter VERB 33 and press ENTER. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing
b. R1 = 00000 ± 00003
c. R2 = 00000 ± 00003
d. R3 = 00000 ± 00003

6.2.9.13 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 15 flashing
b. R1 = +31500 ± 00007
c. R2 = +31500 ± 00007
d. R3 = +31500 ± 00007
e. IG angle = 315 ± 1 deg.
f. MG angle = 315 ± 1 deg.
g. OG angle = 315 ± 1 deg.

6.2.9.14 Enter VERB 33 and press ENTER. After approximately 100 seconds the following data shall be displayed on the CRT.

a. VERB 05 NOUN 30 flashing
b. R1 = 00000 ± 00003
c. R2 = 00000 ± 00003
d. R3 = 00000 ± 00003

6.2.9.15 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 17 flashing
b. R1 = +28900 ± 00007
c. R2 = +28900 ± 00007
d. R3 = +28900 ± 00007
e. IG angle = 289 ± 1 deg.
f. OG angle = 289 ± 1 deg.
g. MG angle = 289 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall light.

6.2.9.16 Enter VERB 33 and press ENTER. After approximately 20 seconds the following data will be displayed on the CRT.

a. VERB 06 NOUN 20 flashing
b. R1 = +00000 ± 00007
c. R2 = +00000 ± 00007
d. R3 = +00000 ± 00007
e. IG angle = 000 ± 1 deg.
f. MG angle = 000 ± 1 deg.
g. OG angle = 000 ± 1 deg.

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

6.2.9.17 Enter VERB 33 and press ENTER. After approximately 15 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66 flashing
b. R1 = 000xx
c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall light.

Record R1 and R2 as the Middle Gimbal CDU drive rate.
MG rate = __R1__ , __R2__ °/sec. The Middle Gimbal CDU drive rate shall be 14 ± 2°/sec.

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6.2.9.18 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66 flashing

b. R1 =000xx

c. R2 = xxxxx

The GIMBAL LOCK lamp on the DSKY's shall extinguish.

Record R1 and R2 as the Inner Gimbal CDU drive rate.
IG rate = R1 . R2 °/sec. The Inner Gimbal CDU drive rate shall be 14 ± 2°/sec.

6.2.9.19 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 30 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66 flashing

b. R1 = 000xx

c. R2 = xxxxx

Record R1 and R2 as the Outer Gimbal CDU drive rate.
OG rate = R1 . R2 , °/ sec The Outer Gimbal CDU drive rate shall be 14 ± 2°/sec.

6.2.9.20 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +00100 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton. Verify R1 = 33xxx.

The ISS WARNING Lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.21 Enter VERB 33 into K148. Press the ENTER pushbutton. After approximately 20 seconds VERB 21 NOUN 22 shall flash on the CRT. Enter +03375 into K148 three times. Press the ENTER pushbutton after each entry. After approximately 100 seconds VERB 01 NOUN 10 flashing shall be displayed on the CRT. Press the ENTER pushbutton.

Enter 00030 into K148. Press the ENTER pushbutton.
Verify R1 = 33xxx.

The ISS WARNING lamp on the Indicator Control Panel shall light.
The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be ON.

6.2.9.22 Enter VERB 33 into K148. Press the ENTER pushbutton. VERB 06 NOUN 55 shall flash on the CRT. The ISS WARNING lamp on the Control Indicator Panel shall extinguish. The ISS WARNING and ISS CDU FAIL discretes on the CRT shall be OFF.

6.2.9.23 Set the OPTICS MODE switch on the Indicator Control Panel to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to CMC.

6.2.9.24 Enter VERB 33, press ENTER. After approximately 25 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66 flashing

b. R1 = 000xx

c. R2 = xxxxx

Record R1 and R2 as the Shaft Optics CDU drive rate.
Shaft rate = R1 . R2 . The Shaft Optics CDU drive rate shall be 7.32 ± 1.82°/sec.

6.2.9.25 Enter VERB 33 into K148. Press the ENTER pushbutton. In about 15 seconds the following data shall be displayed on the CRT.

a. VERB 06 NOUN 66

b. R1 = 0000x

c. R2 = xxxxx

Record R1 and R2 as the Trunnion Optics CDU drive rate. Trunnion rate = R1 . R2 . The Trunnion Optics CDU drive rate shall be 1.83 ± 0.50°/sec.

6.2.9.26 Terminate the Semi-Automatic Moding Check by entering VERB 34 into K148. Press the ENTER pushbutton. Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.10 Zero Optics Test

6.2.10.1 Set the G&N POWER-OPTICS switch on the LEB to OPTICS. Verify Power Supplies.

NOTE: Proceed with this test if 6.2.4 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.2.2 Turn On procedure before proceeding.

6.2.10.2 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

a. VERB 41 NOUN 20, ENTER

b. +00000, ENTER

c. +00000, ENTER

d. +00000, ENTER

6.2.10.3 Insure that the following switches on the G&N Indicator Control Panel are set as follows:

a. TELESCOPE TRUNNION to SLAVE to SXT

b. CONTROLLER COUPLING to DIRECT

c. CONTROLLER SPEED to HI

6.2.10.4 Monitor the Optics CDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.10.5 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following on R1 and R2 of the CRT.

a. R1 = +000.00 ± 000.03 (Shaft Angle)

b. R2 = +00.000 ± 00.006 (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.10.6 Set up the Analog Recorder to monitor the following measurements. Use a chart speed of 10 mm/sec.

a.	CG 3140	SXT Shaft Tach Output
b.	CG 3145	SXT Shaft Motor Control Winding
c.	CG 3150	SXT Trunnion Tach Output
d.	CG 3155	SXT Trunnion Motor Control Winding
e.	CG 3160	SCT Shaft Tach Output
f.	CG 3170	SCT Trunnion Tach Output

6.2.10.7 Push the Optics Hand Controller to the right, driving the SXT Shaft until R1 on the CRT indicates +180 ± 1°. Push the Optics Hand Controller up, driving the SXT Trunnion until R2 on the CRT indicates +75 ± 1°.

6.2.10.8 Start the Analog Recorders and set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO.

6.2.10.9 Monitor the Analog Recorders until all signals return to null. Stop the Analog Recorders. The elapsed time between the initial and final SXT Tach output null shall be less than 15 seconds.

6.2.10.10 Record R1 and R2 on the CRT. The data displayed shall be as follows:

a. R1 = 000.00 ± 000.03

b. R2 = 00.000 ± 00.006

6.2.10.11 Record the Telescope Panel Angle Counter indications. The Shaft Angle shall be 0.0 ± 0.11 degrees. The Trunnion Angle shall be 0.0 ± 0.22 degrees.

6.2.10.12 Set the OPTICS MODE switch on the G&N Indicator Control Panel to MAN.

NOTE: If optics testing will not be continued, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.11 OPTICS Coordinate Transformation Control Test

6.2.11.1 Set the G/N POWER-OPTICS switch on the LEB to OPTICS. Verify Power Supplies.

NOTE: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2, Turn On Procedure, before proceeding.

6.2.11.2 Enter the following into the K-Start. Press the ENTER pushbutton after each entry:

a. VERB 41 NOUN 20, ENTER

b. +00000, ENTER

c. +00000, ENTER

d. +00000, ENTER

6.2.11.3 Verify and/or set the following switches on the G&N Indicator Control Panel to the position indicated.

a. TELESCOPE TRUNNION to SLAVE TO SXT

b. CONTROLLER COUPLING to DIRECT

c. CONTROLLER SPEED TO HI

6.2.11.4 Enter the following into the K-Start to monitor the OPTICS CDU's

VERB 16 NOUN 55, press ENTER

6.2.11.5 Set the OPTICS MODE switch on the G&N Panel to ZERO. Wait 15 seconds. Insure that the Optics zero properly by observing that R1 and R2 of the CRT indicate as follows:

a. R1 = +000.00 ± 000.03 (Shaft Angle)

b. R2 = +00.000 ± 00.006 (Trunnion LOS Angle)

Return the OPTICS MODE switch to MAN.

6.2.11.6 Set up the analog recorders to monitor the following measurements:

a. CG 3160 SCT Shaft Tachometer Output

b. CG 3170 SCT Trunnion Tachometer Output

6.2.11.7 Using the OPTICS CONTROL STICK, drive the Optics until R1 = 225.00 and R2 = 10.000 on the CRT and the DSKY's.

6.2.11.8 Set the CONTROLLER COUPLING switch on the G&N Panel to RSLV and the controller speed switch to MED.

6.2.11.9 Position the movable optics target such that it is centered on the SCT reticle pattern, then start the analog recorders at a chart speed of 10 mm/second.

6.2.11.10 Quickly displace the OPTICS CONTROL STICK 45 ± 10 degrees in the upper right hand quadrant while sighting on the optics target through the SCT eyepiece. The target shall appear to move in the upper right field of view of the SCT at 45 ± 10 deg. Release the control stick when the target leaves the SCT upper right field of view, and immediately record the shaft angle as displayed on R1 of the CRT and DSKY's. The recorded shaft angle shall be +225 ± 10.00 degrees.

6.2.11.11 Stop the analog recorder and measure the elapsed time between the initial and the final signal null conditions for the two measurements. The elapsed time shall be from 24 to 36 seconds.

6.2.11.12 Set the CONTROLLER COUPLING switch on the G&N Panel to DIRECT and drive the Optics with the OPTICS CONTROL STICK until the shaft and trunnion angles as indicated on the SCT TPAC's are approximately zero, then repeat step 6.2.11.5.

NOTE: If optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12 Optics Positional Accuracy Test

6.2.12.1 Proceed with this test if 6.2.3, Operate Power On Test, or 6.2.5.2, Turn-On Procedure has been performed and system operation has not been interrupted. If system operation has been interrupted perform 6.2.5.2, Turn On Procedure, before proceeding. This test requires the use of the G&N Installation Qualification Fixture A23-097 mounted on the Optics Supporting Fixture A14-135. Insure that the qualification fixture has been properly aligned and that both Autosets are visible through the SXT StLOS before proceeding. Insure that lamp power is available to the qualification fixture and to the Portable Lamp Assembly.

6.2.12.2 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify the following:

a. +28 VDC OPTX OPERATE BUS (CG 1530) is 28.8 ± 3 VDC. Record the indication on the CRT.
b. CG 1211 OPTX 28V 800 cps 1% 0 ph not flashing on CRT.
c. CG 1212 OPTX 800 cps 5% - 90 ph not flashing on CRT.

6.2.12.3 Enter the following sequence into the K-Start.

a. VERB 41 NOUN 20 ENTR
b. +00000, ENTER
c. +00000 ENTER
d. +00000 ENTER

6.2.12.4 Insure that the Optics control switches on the G&N Indicator Control Panel are set as follows:

a. OPTICS MODE to MAN
b. CONTROLLER SPEED to LO
c. CONTROLLER COUPLING to DIRECT
d. TELESCOPE TRUNNION to SLAVE to SXT

6.2.12.5 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

6.2.12.6 Resolution Checks.

6.2.12.6.1 Sight through the SXT eyepiece. Using the OPTICS CONTROL STICK, adjust the SXT to obtain the best reflected field of view of the 5-inch autocollimator reticle engravings at the center of the field of view.

6.2.12.6.2 Note that the autocollimator reticle contains a series of lines of different thickness and width. Each set of lines is marked with a number (20, 15, 10, 7, 5, 3) which indicates the angle subtended by one line and one space. View each set of lines to determine the lowest numbered set in which resolution between lines (ability to distinguish separate distinct lines within a set) can be made. Record the number associated with that set of lines. The SXT resolution shall be at least 10 arc seconds at the center of the field of view.

6.2.12.6.3 Repeat 6.2.12.6.1 and 6.2.12.6.2 using the SCT and the SCT resolution chart. The SCT shall have a resolution of at least 3 arc minutes at the center of the field of view.

6.2.12.7 Slave Telescope Mode Checks.

6.2.12.7.1 Enter VERB 16 NOUN 55 into the K-Start. Press the ENTER pushbutton.

6.2.12.7.2 Set the OPTICS MODE switch on the Control Indicator Panel to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.

6.2.12.7.3 Record the SCT Shaft and Trunnion angles as indicated by the TPAC and the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between the TPAC Shaft angle and the Shaft CDU angle shall be ± 0.11° or less. The difference between the TPAC Trunnion angle and the Trunnion CDU angle shall be ± 0.22° or less.

6.2.12.7.4 Using the OPTICS CONTROL STICK and CONTROLLER SPEED switch, drive the SXT Shaft and Trunnion CDU's until R1 = +035.00 ± 0.10 deg. and R2 = +35.000 ± 0.100 deg. Record R1 and R2. Record the Shaft and Trunnion angles as indicated by the TPAC. The difference between the TPAC Shaft angle and Shaft CDU angle shall be ± 0.11° or less. The difference between the TPAC Trunnion angle and Trunnion CDU angle shall be ± 0.22° or less.

6.2.12.7.5 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.

6.2.12.7.6 Set the TELESCOPE TRUNNION switch to the 0° position.

6.2.12.7.7 Remove the plug from the base of the SXT eyepiece and install the Adapter Assembly and Portable Light Assembly. Turn on the light. NOTE: If needed to reduce external light, place a photographers hood over the optics head and retroreflecting prism.

6.2.12.7.8 By sighting through the SCT eyepiece, position the Retroreflecting Prism, Model No. A23-200, to span between the SXT StLOS and SCT LOS such that the illumination from the backlight filament is clearly visible at the center of the field of view.

6.2.12.7.9 Remove the Portable Light from the adapter on the SXT eyepiece and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece. An enlarged projected image of the SCT reticle. should be visible for alignment comparison with the SXT reticle. Using the OPTICS CONTROL STICK, adjust the trunnion CDU to bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle line. Record the Trunnion CDU angle displayed in R2 as XX.XXX degrees. The difference between this angle and the corresponding angle recorded in 6.2.12.7.3 shall be $\pm 0.2^\circ$ or less.

6.2.12.7.10 Replace the Portable Light in the adapter on the SXT eyepiece.

6.2.12.7.11 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT.

6.2.12.7.12 Temporarily disable the SCT TRUNNION electrical drive by carefully unscrewing the SCT TRUNNION Manual Drive until it just releases from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

6.2.12.7.13 Remove the Portable Light from the adapter and direct the light beam into the SCT eyepiece while sighting into the SXT eyepiece as in step 6.2.12.7.9. Again using the OPTICS CONTROL STICK, bring the SCT horizontal reticle line into coincidence with the SXT horizontal reticle. Record the Trunnion CDU angle displayed in R2. The difference between this angle and the corresponding angle measured in 6.2.12.7.3 shall be $\pm 0.2^\circ$or less. Replace the Portable Light Assembly in the adapter.

6.2.12.7.14 Replace the SCT TRUNNION Manual Drive in the panel.

6.2.12.7.15 Use the OPTICS CONTROL STICK to drive the Trunnion CDU to $+25.000^\circ \pm 0.006^\circ$ as indicated on R2. Maintain the Shaft CDU at $000.00^\circ \pm 0.01^\circ$ as indicated on R1.

6.2.12.7.16 Set the TELESCOPE TRUNNION switch to 25°. After 30 seconds has elapsed, record the TPAC trunnion angle and Trunnion CDU angle displayed in R2. The difference shall be $\pm 0.22^\circ$ or less. Record the Shaft CDU angle displayed in R1.

6.2.12.7.17 Temporarily disable the electrical drive to the SCT Trunnion and SCT Shaft by unscrewing the SCT Trunnion and Shaft Manual Drive items until they just release from the panel. Do not rotate further, as this would displace the SCT LOS from the desired reference position.

6.2.12.7.18 Reposition the Retroreflecting Prism so that it is inclined at an angle of 25° downward and spans the SCT LOS and SXT StLOS. Sight into the SCT and adjust the prism so that illumination from the backlight filament is again visible at the center of the field of view. Remove the Portable Light Assembly from the SXT eyepiece adapter and direct the light into the SCT eyepiece while sighting through the SXT eyepiece. Observe the comparison of SCT and SXT reticles. Adjust the Trunnion CDU and Shaft CDU angles with the OPTICS CONTROL STICK to bring the two reticle patterns into coincidence. Record the Shaft and Trunnion CDU angles as indicated in R1 and R2 of the DSKY. The difference between each of these angles and the respective angles recorded in 6.2.12.7.16 shall be ± 0.2 degrees or less.

6.2.12.7.19 Replace the SCT Shaft and Trunnion Manual Drive items. Replace the Portable Light Assembly in the adapter. Set the TELESCOPE TRUNNION switch to SLAVE TO SXT. Set the OPTICS MODE switch to ZERO. Wait 15 seconds and then set the OPTICS MODE to MAN. Remove the Retroreflecting Prism and photographer's hood if used.

6.2.12.8 SXT Parallelism Tests

6.2.12.8.1 Using the OPTICS CONTROL STICK drive the SXT StLOS Trunnion to +15.000° ± 2° as indicated in R2 of the DSKY. Maintain a Shaft CDU angle of 000.00 ± 0.01 degrees.

6.2.12.8.2 Sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to superimpose the SXT LLOS horizontal reticle image upon the autocollimator horizontal filar. Record the autocollimator reading.

6.2.12.8.3 Repeat 6.2.12.8.2 twice. Calculate and record the average of the three autocollimator readings.

6.2.12.8.4 Set the OPTICS MODE switch to ZERO. After 15 seconds return the OPTICS MODE switch to MAN.

6.2.12.8.5 Again sight through the 5-inch autocollimator eyepiece and adjust the measurement knob to bring the SXT StLOS horizontal reticle and autocollimator horizontal filar images to coincide. Record the autocollimator reading.

6.2.12.8.6 Repeat 6.2.12.8.5 twice. Calculate and record the average of the three autocollimator readings. The average value obtained here shall not differ from that obtained in 6.2.12.8.3 by more than 10 arc seconds.

6.2.12.8.7 Using the OPTICS CONTROL STICK drive the SXT Trunnion angle to 85.000° ± 5° as indicated on R2 of the DSKY. Set the CONTROLLER SPEED to LO and drive the SXT Trunnion to +90.000° ± 0.006° as indicated on R2 of the DSKY. Insure that the SXT Shaft angle remains at 000.00 ± 0.02 degrees as indicated by R1 on the DSKY.

6.2.12.8.8 Sight through the SXT. Two reticle patterns shall be visible. Use the OPTICS CONTROL STICK to adjust the SXT Trunnion angle until the two horizontal reticle lines are coincident. Record the Trunnion CDU angle displayed in R2. The Trunnion CDU angle shall be 90.000 ± 0.010 degrees.

6.2.12.8.9 Remove the Portable Light Assembly and Adapter Assembly from the base of the SXT eyepiece. Replace the SXT eyepiece plug. NOTE: If Optics testing will not continue, set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

6.2.12.9 Shaft and Trunnion Positional Accuracy Checks.

6.2.12.9.1 Set the OPTICS MODE switch to ZERO. After 15 seconds, return the switch to MAN.

6.2.12.9.2 Sight through the SXT. Using the Control Stick align the SXT StLOS with optical target No. 1 on the G&N Qualification Fixture.

6.2.12.9.3 Enter VERB 16 NOUN 55, ENTER into the DSKY. Record the value of R1 and R2 displayed on the CRT. Record the Shaft and Trunnion angles from the TPAC.

6.2.12.9.4 Sight through the SXT. Using the Control Stick align the SXT StLOS with Optical Target no. 2.

6.2.12.9.5 Record the value in R1 and R2 on the DSKY. Record the Shaft and Trunnion angles from the TPAC.

6.2.12.9.6 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. After 15 seconds set the switch to MAN, then CMC.

6.2.12.9.7 Enter VERB 41, NOUN 55, ENTER into the DSKY. Enter the value for R1 from 6.2.12.9.3 into the DSKY and press ENTER. Enter the value for R2 from 6.2.12.9.3 into the DSKY and press ENTER.

6.2.12.9.8 Sight through the SXT. The StLOS should be centered on Optical Target No. 1. Record the Shaft and Trunnion angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.9.3 shall be less than 0.25 degrees. Record the difference.

6.2.12.9.9 Enter VERB 41, NOUN 55, ENTER into the DSKY. Enter the value for R1 from 6.2.12.9.5 into the DSKY and press the ENTER pushbutton. Enter the value for R2 from 6.2.12.9.5 into the DSKY and press the ENTER pushbutton.

6.2.12.9.10 Sight through the SXT. The StLOS should be centered on Optical Target No. 2. Record the Shaft and Trunnion angles from the TPAC. The difference between these values and the corresponding values recorded in 6.2.12.9.5 shall be less than 0.25 degrees. Record the difference.

6.2.12.9.11 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN.

6.2.13 Optic Slew Rate Test

6.2.13.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.13.2 Set/verify the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify the following signals on the CRT.

a. +28 VDC OPTICS OPERATE BUS (CG 1530) is +29.0 ± 3.0 VDC
b. OPTX 28V 800 cps 1% 0° ph not flashing on the CRT
c. OPTX 28V 800 cps 5% -90° ph not flashing on the CRT

6.2.13.3 Enter the following sequence into K148. Press the ENTER pushbutton after each entry.

a. VERB 41 NOUN 20, ENTER
b. + 00000, ENTER
c. + 00000, ENTER
d. + 00000, ENTER

6.2.13.4 Verify and/or set the following switches on the G&N Indicator Control Panel to the positions indicated.

a. TELESCOPE TRUNNION to SLAVE to SXT
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to HI

6.2.13.5 Monitor the OCDU's by entering VERB 16 NOUN 55 into K148. Press the ENTER pushbutton.

6.2.13.6 Set the OPTICS MODE switch on the G&N Indicator Control Panel to ZERO. Wait 15 seconds. Verify the Optics have zeroed properly by observing the following data displayed in R1 and R2 on the DSKY.

a. R1 = + 000.00 ± 000.03 (Shaft Angle)
b. R2 = + 00.000 ± 00.006 (Trunnion LOS Angle)

Set the OPTICS MODE switch on the G&N Indicator Panel to MAN.

NOTE: Read and understand step 6.2.13.7 before proceeding.
Do not hold Control Stick at upper limit more than 10 seconds
or exceed a trunnion angle of 85°.

Trunnion Slew Rate - HI Speed

6.2.13.7 Push and hold the Optics Control Stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

a. R2 = ± XX.XXX (Trunnion LOS angle in deg.)
b. R3 = ∓ XXX.XX (Time in seconds)

6.2.13.8 Perform the following calculations:

a. Difference between R2 displays = ______ (trun. angle)
b. Difference between R3 displays = ______ (time)
c.

$$\frac{\text{trun. angle}}{\text{time}} = \_\_ \text{ deg/sec}$$

The Trunnion slew rate shall be 10.0 ± 2.0 deg/sec.

Shaft Slew Rate - HI Speed

6.2.13.9 Using the Optics Control Stick, drive the Trunnion LOS Angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand step 6.2.13.10 before proceeding.
Do not hold Control Stick at right limit for more than
10 seconds or exceed a shaft angle of 250°.

6.2.13.10 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 5 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form.

R1 = ± XXX.XX (Shaft angle in deg.)
R3 = ∓ XXX.XX (Time in seconds)

6.2.13.11 Perform the following calculations

a. Difference between R1 displays = ______ (shaft angle)
b. Difference between R3 displays = ______ (time)
c.

$$\frac{\text{shaft angle}}{\text{time}} = \_\_\_ \text{ deg/sec}$$

The Shaft Slew Rate shall be 19.5 ± 3.9 deg/sec.

Trunnion Slew Rate - MED Speed

6.2.13.12 Using the Optics Control Stick, drive the shaft angle back to approximately zero degrees as indicated on the TPAC. Set the OPTICS MODE switch to zero. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to MED.

NOTE: Read and understand 6.2.13.13 before proceeding. Do not hold control stick at upper limit for more than 20 seconds.

6.2.13.13 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
b. R3 = XXX.XX (Time in seconds)
c. $\frac{\text{Trunnion angle}}{\text{Time}} = \_.\_\,\_$ deg/sec

The Trunnion slew rate shall be 1.0 ± 0.2 deg/sec.

Shaft Slew Rate - MED Speed

6.2.13.15 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.16 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.16 Push and hold the Optics Control Stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

a. R1 = ± XXX.XX (Shaft Angle in degrees)
b. R3 = ± XXX.XX (Time in seconds)

6.2.13.17 Perform the following calculations

a. Difference between R1 displays = ------ (Shaft Angle)
b. Difference between R3 displays = ------ (Time)
c.

$$\frac{\text{Shaft Angle}}{\text{Time}} = \_.\_\_ \text{ deg/sec}$$

The Shaft Slew Rate shall be 2.0 ± 0.4 deg/sec.

Trunnion Slew Rate - LO Speed

6.2.13.18 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN. Set the CONTROLLER SPEED switch to LO.

NOTE: Read and understand 6.2.13.19 before proceeding. Do nothold control stick at upper limit for more than 30 seconds.

6.2.13.19 Push and hold the Optics Control stick to its upper limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R2 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R2 and R3. The data displayed is in the following form:

a. R2 = XX.XXX (Trunnion LOS Angle in degrees)
b. R3 = XXX.XX (Time in seconds)

6.2.13.20 Perform the following calculations

a. Difference between R2 displays = XX.XXX (Trunnion Angle)
b. Difference between R3 displays = XXX.XX (Time)
c.

$$\frac{\text{Trunnion Angle}}{\text{Time}} = \_.\_\_ \text{ deg/sec}$$

The Trunnion Slew Rate shall be 0.10 ± 0.02 deg/sec.

Shaft Slew Rate - LO Speed

6.2.13.21 Set the OPTICS MODE switch to ZERO. Wait 15 seconds. Set the OPTICS MODE switch to MAN.

NOTE: Read and understand 6.2.13.22 before proceeding. Do not hold control stick at right limit for more than 20 seconds.

6.2.13.22 Push and hold the Optics Control stick to its right limit. Approximately 2 seconds later press the MARK pushbutton. Immediately record the DSKY display in R1 and R3. Approximately 10 seconds after the first mark, again press the MARK pushbutton and record the new display in R1 and R3. The data displayed is in the following form:

a. R1 = XXX.XX (Shaft Angle in degrees)
b. R3 = XXX.XX (Time in seconds)

6.2.13.23 Perform the following calculations:

a. Difference between R1 displays = _ _ _ . _ _ (Shaft Angle)
b. Difference between R3 displays = _ _ _ . _ _ (Time)
c. $\frac{\text{Shaft Angle}}{\text{Time}}$ = _ .)) deg/sec

The Shaft Slew Rate shall be 0.20 ± 0.04 deg/sec.

6.2.13.24 Set the G/N POWER-OPTICS switch on LEB Lighting Control Panel to OFF.

6.2.14 Stabilization Loop Step Response Test.

6.2.14.1 Proceed with this test if the Operate Power On Test of 6.2.3 has been performed and system operation has not been interrupted. If system operation has been interrupted, perform the Turn On Procedure of 6.2.5.2 before proceeding. Insure that the Carry-on Command Stimuli Unit, Model No. C14-200, is installed and connected.

6.2.14.2 Enter VERB 36 into K148. Press the ENTER pushbutton, then the ERROR RESET pushbutton.

6.2.14.3 Inner Gimbal Response Test.

6.2.14.4.1 Enter code 2032000000 in C-START Module 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2117 IGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.4.2 Enter VERB 41 NOUN 20 into K148. Press ENTER pushbutton.

6.2.14.4.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.4.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.4.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.4.6 Enter 1000 into 4A2-A6-R155. The top part of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.4.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the IG stabilization loop.

CAUTION: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.4.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.4.9 Enter 0000 into 4A2-A6-R155; the top part of switch should be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the IG Stabilization Loop. The bottom part of switch shall be extinguished.

6.2.14.4.10 After the transient has died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the settling of the error signal to a value equal to ±5% of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.4.10.1 The inner gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.4.10.2 The maximum number of overshoots on the IGA Servo Error signals shall be three.

6.2.14.5 Middle Gimbal Response Test.

6.2.14.5.1 Enter code 2028000000 into C-START MODULE 4A1-A5-C156. Press the XEQ/SEAL pushbutton to call up CG 2147 MGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.5.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.5.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.5.4 Enter VERB 42 into K148. Press ENTER.

6.2.14.5.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.5.6 Enter 0100 into 4A2-A6-R155. The top part of switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.5.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the MG Stabilization Loop.

CAUTION: If the transient caused by the step input does not die within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.5.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.5.9 Enter 0000 into 4A2-A6-R155. The top part of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-R155 are illuminated. Start analog recorder. Press XEQ/SEAL pushbutton to remove the step input to the MG stabilization loop.

6.2.14.5.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the settling of the error signal to a value equal to ±5% of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.5.10.1 The middle gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.5.10.2 The maximum number of overshoots on the MGA Servo Error signals, shall be three.

6.2.14.6 Outer Gimbal Response Test.

6.2.14.6.1 Enter code 2026000000 in C-START Module 4A1-A5-C156. Press XEQ/SEAL Pushbutton to call up CG 2177 OGA SERVO ERROR on 4A1-A3-CH1.

6.2.14.6.2 Enter VERB 41 NOUN 20 into K148. Press ENTER.

6.2.14.6.3 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 30 seconds.

6.2.14.6.4 Enter VERB 42 into K148. Press ENTER pushbutton.

6.2.14.6.5 Enter +00000 into K148 three times. Press ENTER after each entry. Wait 90 seconds.

6.2.14.6.6 Enter 0010 into 4A2-A6-R155. The top half of the switch shall be illuminated. Insure that no other function switches on 4A2-A6-R155 are illuminated.

6.2.14.6.7 Press XEQ/SEAL pushbutton on 4A2-A6-R155 to enter a DC step into the OG Stabilization Loops.

NOTE: If the transient caused by the step input does not die out within 15 seconds, remove the IMU OPERATE power by setting the G/N POWER IMU switch on the LEB Lighting Control Panel to OFF.

6.2.14.6.8 Set up Analog Recorder 4A1-A3 using a chart speed of 100 mm/sec.

6.2.14.6.9 Enter 0000 into 4A2-A6-R155. The top half of the switch shall be extinguished. Insure that no other function switches on 4A2-A6-155 are illuminated. Start analog recorder. Press the XEQ/SEAL pushbutton to remove the step input to the OG Stabilization Loop.

6.2.14.6.10 After the transients have died out, stop the analog recorder. Record the loop response time by measuring the time interval between removing the step (initial disturbance) and the settling of the error signal to a value equal to ±5% of the original step amplitude. In addition, record the total number of overshoots.

6.2.14.6.10.1 The outer gimbal stabilization loop response time shall be less than 0.1 second.

6.2.14.6.10.2 The maximum number of overshoots on the OGA Servo Error Signals shall be three.

6.2.14.7 Enter VERB 40 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.1 Enter VERB 41 NOUN 20 into K148. Press the ENTER pushbutton.

6.2.14.7.2 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.3 Enter +00000 into K148. Press the ENTER pushbutton.

6.2.14.7.4 Enter +00000 into K148. Press the ENTER pushbutton.

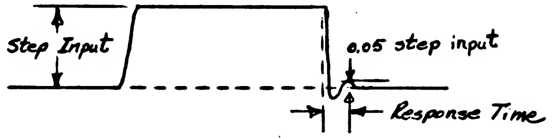

Figure 1. Typical Step Input Response

6.2.15 IRIG Scale Factor Test

6.2.15.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.15.2 Verify that the IMU OPERATE power has been applied for a minimum of 1 hour, and that at least 1 hour has elapsed since running of the Gimbal Friction Test, 6.2.7.

6.2.15.3 Set up the Analog Recorders to monitor the following signals:

a. CG 2117 IG SERVO ERROR
b. CG 2147 MG SERVO ERROR
c. CG 2177 OG SERVO ERROR
d. CG 2120 IG TM CURRENT
e. CG 2150 MG TM CURRENT
f. CG 2180 OG TM CURRENT

6.2.15.3.1 Start the analog recorder chart drive using a chart speed of 1 mm/sec. The recorder shall run for the duration of 6.2.15.

6.2.15.4 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.15.5 Enter 00005 into K148. Press the ENTER pushbutton.

6.2.15.6 VERB 06 NOUN 61 shall flash on CRT and the following displayed in R1 and R2:

R1 = ±xxxxx (some Nav. Base aximuth)
R2 = ±xxxxx (some test site latitude; see Table I)

6.2.15.7 If the values displayed in R1 and R2 are correct, proceed with test, if not perform the following sequence:

a. To correct R1, on the K-Start enter VERB 21, press ENTER pushbutton, ±xxx.xx, press ENTER (±xxx.xx is correct nav. base azimuth).

b. To correct R2, on the K-Start enter VERB 22, press ENTER pushbutton, +xx.xxx, press ENTER (obtain correct site latitude from Table I).

Table I

Site	Latitude
NAA	+33.921
MSC	+29.556
KSC	+28.516

6.2.15.8 Verify the correct displays on CRT R1 and R2, then on the K-Start enter VERB 33 and press ENTER pushbutton.

6.2.15.9 VERB 21 NOUN 30 shall flash on the CRT, requesting a load of the test number.

Enter the desired test number from Table I and press the ENTER pushbutton.

Table I. Test Numbers and Positions for IRIG Tests

Test Number	Gyro Being Tested and Direction of Torque
+00001	+X
+00002	+Y
+00003	+Z
-00001	-X
-00002	-Y
-00003	-Z

NOTE: If all gyros are being tested, the test must be repeated once for each Test Number in Table I in the sequence listed. If only one gyro is being tested, the test need only be repeated for the two applicable test numbers.

6.2.16 IMU Performance Test

6.2.16.1 Proceed with this test if the Operate Power On Test of 6.2.3 or the Turn On Procedure of 6.2.5.2 has been completed and system operation has not been interrupted. If the system operation has been interrupted, perform Turn On Procedure of 6.2.5.2 before proceeding with this test.

6.2.16.2 Enter VERB 01 NOUN 10 into K148. Press the ENTER pushbutton. Enter 00003 into K148. Press the ENTER pushbutton. Record R1 = AAAAA and the time of day.

6.2.16.3 Enter VERB 21 NOUN 02 into K148. Press the ENTER pushbutton. Enter 01300 into K148. Press ENTER. Enter AAAAA into K148. Press ENTER.

6.2.16.4 Enter VERB 06 NOUN 02 into K148. Press ENTER. Enter 01300 into K148. Press ENTER. Record R1 = BBBBB.

6.2.16.5 Perform the following calculations:

a. $\frac{\text{R1 (BBBBB) X 5.12}}{3600}$ = CCCC.C (hrs. in high order scaler channel 3)

b. 23.3 - CCC.C = DDDDD Hrs.

c. Add DDDDD to time of day recorded in step 1.

Do NOT enter any of the PIPA scale factor tests within -0.2 hours of the gime of day calculated in step 6.2.16.5c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA scale factor test is being performed at this time, unacceptable test results will occur.

6.2.16.6 Verify that the IMU Operate Power has been applied for at least one hour.

6.2.16.7 Test Initiation.

6.2.16.7.1 Enter the following into the K-Start:

a. VERB 01 NOUN 01, ENTER

b. 00362, ENTER
Record R1 = XXXXX

6.2.16.7.2 Enter the following into the K-Start:

a. VERB 21 NOUN 01, ENTER

b. 00362, ENTER

c. XXXXY', ENTER where Y' is determined from Table XI and XXXX is that recorded in 6.2.16.7.1.

TABLE XI

Y (from 6.2.16.7.1)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.16.7.3 Enter VERB 57 into K148. Press the ENTER pushbutton.

6.2.16.7.4 Enter 00001 into K148. Press the ENTER pushbutton.

6.2.16.7.5 VERB 06 NOUN 61 shall appear flashing on CRT and will contain the following information:

R1 = xxx.xx (Some NB Azimuth)
R2 = xx.xxx (Some Test Site Latitude)

Insure that R1 = Correct NB Azimuth and R2 = Present Test Site Latitude from Table XX.

6.2.16.7.6 If R1 does not contain the correct NB Azimuth, enter the following sequence into K148.

a. VERB 21, ENTER
b. +xxx.xx, ENTER (where +xxxxx is the NB Azimuth)

6.2.16.7.7 If R2 does not contain present Test Site Latitude enter the following sequence into K148:

a. VERB 22, ENTER

b. Proper Data from Table XX, ENTER

TABLE XX

Location	Latitude
NAA	+33.921
MSC	+29.556
KSC	+28.516

6.2.16.7.8 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.9 VERB 06 NOUN 66 shall appear flashing on CRT. Verify that the following values appear on CRT.

R1 = +00900
R2 = +00000
R3 = +00001

6.2.16.7.10 If the contents of R1 on the CRT are not +00900, enter the following sequence into K148.

a. VERB 21, ENTER

b. +00900, ENTER

6.2.16.7.11 If the contents of R3 on the CRT are not +00000, enter the following sequence into K148:

a. VERB 22, ENTER

b. +00000, ENTER

6.2.16.7.12 If the contents of R3 on the CRT are not +00001, enter the following sequence into K148:

a. VERB 23, ENTER b. +00001, ENTER

6.2.16.7.13 Verify correct display in R1, R2, and R3. Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.16.7.14 After approximately 17 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.

6.2.16.7.15 Enter VERB 33 into K148. Press the ENTER pushbutton.

6.2.16.7.16 After approximately 90 sec, VERB 06, NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R1 and R2 on the calculation sheet.

6.2.16.7.17 Enter VERB 34 into K148. Press the ENTER pushbutton.

6.2.16.7.18 Repeat steps 6.2.16.3.9 through 6.2.16.3.16, substituting position number +00002 in R3.

6.2.16.7.19 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.20 After approximately 67 minutes, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the value on CRT for R2 on the calculation sheet.

6.2.16.7.21 Repeat steps 6.2.16.3.8 through 6.2.16.3.16, substituting position number +00003 in R3.

6.2.16.7.22 Repeat steps 6.2.16.3.17 through 6.2.16.3.20, substituting position number +00004 in R3.

6.2.16.7.23 Enter VERB 33 into K148. Press ENTER pushbutton.

6.2.16.7.24 VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

a. R1 = +00900

b. R2 = +00000

c. R3 = +00005

If data is incorrect perform steps 6.2.16.3.10 through 6.2.16.3.12 entering the correct data. Enter VERB 33 into K148. Press ENTER pushbutton.

The PROGRAM ALARM and GIMBAL LOCK status lights shall be illuminated on the DSKY.

6.2.16.7.25 Press the RESET pushbutton. The Program Alarm lamp shall extinguish. In approximately 90 sec, VERB 06 NOUN 66 shall appear flashing on the CRT. Record the data displayed in R1 and R2 on the CRT.

6.2.16.7.26 Enter VERB 34 into K148. Press ENTER pushbutton. Repeat steps 6.2.16.3.24 thru 6.2.16.3.25 substituting position no. +00006.

6.2.16.7.27 Enter VERB 34 into K148. Press the ENTER pushbutton. VERB 06 NOUN 66 shall flash on the CRT. Verify the following data is also displayed on the CRT.

6.2.16.7.27 (continued)

a. R1 = +00900

b. R2 = +00000

c. R3 = +00007

If the data is incorrect perform steps 6.2.16.3.10 thru 6.2.16.3.12 entering the correct data.

6.2.16.7.28 Enter VERB 33 into K148. Press ENTER pushbutton. The GIMBAL LOCK status lamp shall extinguish. In approximately 17 minutes VERB 06 NOUN 66 shall flash on the CRT. Record the data displayed in R2 of the CRT.

6.2.16.7.29 Repeat steps 6.2.16.3.27 and 6.2.16.3.28 substituting position no. +00008 in R3.

6.2.16.7.30 Repeat steps 6.2.16.3.27 and 6.2.16.3.28 substituting position no. +00009 in R3.

6.2.16.7.31 Repeat steps 6.2.16.3.27 and 6.2.16.3.28 substituting position no. +00010 in R3.

6.2.16.8 To terminate the IMU Performance Test, enter VERB 36 into K148. Press ENTER pushbutton.

6.2.16.9 Enter the following sequence in K148.

a. VERB 40 NOUN 20, ENTER
b. VERB 41 NOUN 20, ENTER
c. +00000, ENTER
d. +00000, ENTER
e. +00000, ENTER

6.2.16.10 Calculations

TABLE XXI

Position No. as Displayed in R3	Quantity Being Measured
+00001	+NBDY +X PIPA G
+00002	+NBDZ -X PIPA G -NBDX + ADIAX
+00003	-NBDX +Z PIPA G
+00004	+NBDY + ADSRAY -Z PIPA G +NBDZ + ADIAZ
+00005	+Y PIPA G
+00006	-Y PIPA G
+00007	-NBDX + .707 ADSRAX

6.2.16.10 (continued)

TABLE XXI (continued)

Position No. as Displayed in R3	Quantity Being Measured
+00008	.707 (-NBDZ - NBDY)+.5(ADIAZ - ADIAY) +.5 (ADSRAY + ADSRAZ)
+00009	-NBDZ + .707 ADSRAZ
+00010	.707 (NBDY - NBDX)+.5(ADIAY - ADIAX) +.5 (ADSRAX)

6.2.16.10.1 **Measured Values**

	Line	Position No.	Step No.	Parameter	Recorded Value
6.2.16.10.1.1	1	+00001	6.2.16.7.14	+NBDY	R2
6.2.16.10.1.2	2	+00001	6.2.16.7.16	+XPIPAG	R1 • R2
6.2.16.10.1.3	3	+00002	6.2.16.7.14	+NBDZ	R2
6.2.16.10.1.4	4	+00002	6.2.16.7.16	-X PIPAG	R1 • R2
6.2.16.10.1.5	5	+00002	6.2.16.7.20	-NBDX + ADIAX	R2
6.2.16.10.1.6	6	+00003	6.2.16.7.14	-NBDX	R2
6.2.16.10.1.7	7	+00003	6.2.16.7.16	+ZPIPAG	R1 • R2
6.2.16.10.1.8	8	+00004	6.2.16.7.14	+NBDY + ADSRAY	R2
6.2.16.10.1.9	9	+00004	6.2.16.7.16	-ZPIPAG	RL • R2
6.2.16.10.1.10	10	+00004	6.2.16.7.20	+NBDZ + ADIAZ	R2
6.2.16.10.1.11	11	+00005	6.2.16.7.25	+YPIPAG	R1 • R2
6.2.16.10.1.12	12	+00006	6.2.16.7.25	-YPIPAG	RL • R2
6.2.16.10.1.13	13	+00007	6.2.16.7.28	-NBDX + .707ADSRAX	R2
6.2.16.10.1.14	14	+00008	6.2.16.7.28	.707 (-NBDZ-NBDY) +.5 (ADIAX-ADIAY +.5 (ADSRAY + ADSRAZ)	R2
6.2.16.10.1.15	15	+00009	6.2.16.7.28	-NBDZ + .707 ADSRAZ	R2
6.2.16.10.1.16	16	+00010	6.2.16.7.28	.707 (NBDY - NBDX) + .5 (ADIAY - ADIAX) +.5 ADSRAX	R2

6.2.16.10.2 Obtain data from last historical IRIG and PIPA test and complete Table X_{1-1}.

Table X_{1-1}

Parameter	Units	Recorded Value
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAY	meru/g	
ADIAZ	meru/g	
X PIPA S.F. Error	PPM	
Y PIPA S.F. Error	PPM	
Z PIPA S.F. Error	PPM	
X PIPA Bias	cm/sec^2	
Y PIPA Bias	cm/sec^2	
Z PIPA Bias	cm/sec^2	

6.2.16.10.3 Obtain data from the second last historical IRIG and PIPA test and complete Table X_{1-2}.

TABLE X_{1-2}

Parameter	Units	Recorded Value
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAY	meru/g	
ADIAZ	meru/g	
X PIPA S.F. Error	PPM	
Y PIPA S.F. Error	PPM	
Z PIPA S.F. Error	PPM	
X PIPA Bias	cm/sec^2	
Y PIPA Bias	cm/sec^2	
Z PIPA Bias	cm/sec^2	

6.2.16.10.4 Obtain data from the third last historical IRIG and PIPA test and complete Table X_{1-3}.

TABLE X_{1-3}

Parameter	Units	Recorded Value
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAY	meru/g	
ADIAZ	meru/g	
X PIPA S.F. Error	PPM	
Y PIPA S.F. Error	PPM	
Z PIPA S.F. Error	PPM	
X PIPA Bias	cm/sec^2	
Y PIPA Bias	cm/sec^2	
Z PIPA Bias	cm/sec^2	

6.2.16.10.5 Compute the PIPA Scale Factor error in parts per million from the values recorded in 6.2.16.10.1 and record in Table X_1.

a. PIPA S.F. Error = $\left[1.000000 - \frac{(2\ \text{local g})}{+\text{PIPAG}-(-\text{PIPAG})}\right] 10^6$

b. X PIPA S.F. Error = $\left[1.000000 - \frac{(2\ \text{local g})}{\text{line 2 - line 4}}\right] 10^6$

c. Y PIPA S.F. Error = $\left[1.000000 - \frac{(2\ \text{local g})}{\text{line 11-line 12}}\right] 10^6$

d. Z PIPA S.F. Error = $\left[1.000000 - \frac{(2\ \text{local g})}{\text{line 7 - line 9}}\right] 10^6$

The PIPA S.F. Error shall not exceed ±2000 PPM

TABLE XXII Local Gravity values

Location	Local Gravity (cm/sec^2)
NAA	979.56
MSC	979.29
KSC	979.24

6.2.16.10.6 Compute the PIPA Bias in cm/sec^2 from the values recorded in 6.2.16.10.1 and record in Table X_1.

a. PIPA Bias = $\frac{+\text{PIPAG} + (-\text{PIPAG})}{2}$

b. X PIPA Bias = $\frac{\text{line 2 + line 4}}{2}$

c. Y PIPA Bias = $\frac{\text{line 11 + line 12}}{2}$

d. Z PIPA Bias = $\frac{\text{line 7 - line 9}}{2}$

The PIPA Bias shall not exceed ±2.28 cm/sec^2.

6.2.16.10.7 Calculate NBD, ADSRA, and ADIA from the values recorded in 6.2.16.10.1 and record in Table X_1.

a. NBDX = - (line 6) =
NBDX = - (line 1 =
NBDZ = line 3 =
NBD shall not exceed ± 15 meru.

6.2.16.10.7 (continued)

b. ADSRAX = $\frac{(\text{line } 13 - \text{line } 6)}{.707}$ =

ADSRAY = line 8 - line 1

ADSRAZ = $\frac{\text{line } 15 + \text{line } 3}{.707}$

ADSRA shall not exceed ± 40 meru/g.

c. ADIAX = line 5 - line 6

ADIAY = $\frac{\text{line } 16 - .707\ (\text{NBDY}-\text{NBDX}) - .5\ (\text{ADSRAX} - \text{ADIAX})}{.5}$

ADIAZ = line 10 - line 3

ADIA shall not exceed ± 100 meru/g

6.2.16.10.8 Perform the following calculations for each term in Table X_i, and record the results in Table D.

$D_1 = \left| X_{i-1} - X_i \right|$

$D_2 = \left| X_{i-1} - X_i \right| + \left| X_{i-2} - X_{i-1} \right|$

$D_3 = \left| X_{i-3} - X_{i-2} \right| + \left| X_{i-2} - X_{i-1} \right| + \left| X_{i-1} - X_i \right|$

X_i = Data point just obtained

X_{i-i} = last historical data point

X_{i-2} = second last historical data point

X_{i-3} = third last historical data point

NOTE: D_1 calculations begin with the first data point after ISS Pre-Vib; D_2 calculations begin with the second data point after ISS Pre-Vib; D_3 calculations begin with the third data point after Pre-Vib.

TABLE X_1

Parameter	Units	Calculated Value
NBDX	meru	
NBDY	meru	
NBDZ	meru	
ADSRAX	meru/g	
ADSRAY	meru/g	
ADSRAZ	meru/g	
ADIAX	meru/g	
ADIAY	meru/g	
ADIAZ	meru/g	
X PIPA S.F. Error	PPM	
Y PIPA S.F. Error	PPM	
Z PIPA S.F. Error	PPM	
X PIPA Bias	cm/sec^2	
Y PIPA Bias	cm/sec^2	
Z PIPA Bias	cm/sec^2	

TABLE D

PARAMETER	UNITS	D_1	MAX.	D_2	MAX.	D_3	MAX.
NBDX	meru		6		9		11
NBDY	meru		6		9		11
NBDZ	meru		6		9		11
ADSRAX	meru/g		14		21		25
ADSRAY	meru/g		14		21		25
ADSRAZ	meru/g		14		21		25
ADIAX	meru/g		17		33		40
ADIAY	meru/g		17		33		40
ADIAZ	meru/g		17		33		40
X PIPA S.F. Error	PPM		400		500		600
Y PIPA S.F. Error	PPM		400		500		600
Z PIPA S.F. Error	PPM		400		500		600
X PIPA Bias	cm/sec^2		0.5		0.7		0.9
Y PIPA Bias	cm/sec^2		0.5		0.7		0.9
Z PIPA Bias	cm/sec^2		0.5		0.7		0.9

6.2.16.10.9 Failure to meet the above criteria shall result in retest according to 5.4.2.

6.2.17 SXT-NB-Fine Alignment Test

6.2.17.1 Perform Master Initialization 6.2.5.3 before proceeding.

6.2.17.2 Prior to performing this test, the G&N Installation Qualification Fixture shall be installed on the supporting fixture and adjusted to permit proper operation of the G&N optics. The G&N shall have had OPERATE power applied for a minimum of 1 hour.

6.2.17.3 Set the G/N POWER-OPTICS switch to OPTICS. Verify that +28 VDC OPTICS OPERATE BUS (CG 1530) is +28.0 ± 3.0 VDC. Verify that the OPTX 28V 800 cps 1% 0° ph (CG 1211) and OPTX 28V 800 cps 5% -90° ph (CG 1212) are not flashing on the CRT.

6.2.17.4 Enter the following into K148.

a. VERB 01 NOUN 10, ENTER
b. 00003, ENTER
c

Record R1 = AAAAA and the time of day.

6.2.17.5 Enter the following into K148.

a. VERB 21 NOUN 02, ENTER
b. 01300, ENTER
c. AAAAA, ENTER
d. VERB 06 NOUN 02, ENTER
e. 01300, ENTER

Record R1 = BBBBB

6.2.17.6 Perform the following calculations:

a. $\frac{\text{R1 (BBBBB)} \times 5.12}{3600}$ = CCCC.C (Hrs. in high order scaler channel 3)

b. 23.3 - CCCC.C = DDDDD Hrs.

c. Add DDDDD to time of day recorded in step 1.

DO NOT enter any of the PIPA misalignment tests within -0.2 hours of the time of day calculated in step 6.2.17.6.c. This is the time at which the high order scaler, channel 3, will overflow. If a PIPA misalignment test is being performed at this time, unacceptable test results will occur.

6.2.17.7 On the G&N Indicator Control Panel set the following switches to the position indicated.

a. TELESCOPE TRUNNION to SLAVE to SXT
b. CONTROLLER COUPLING to DIRECT
c. CONTROLLER SPEED to LO
d. OPTICS MODE to ZERO

6.2.17.8 Enter the following into the DSKY:

a. VERB 01 NOUN 01, ENTER
b. 00362, ENTER

Record R1 = XXXXY

6.2.17.9 Enter the following into the DSKY:

a. VERB 21 NOUN 01, ENTER
b. 00362, ENTER
c. XXXXY', ENTER where Y' is determined by Table II and XXXX is that recorded above.

TABLE II

Y (from 6.2.17.8)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.17.10 Initiate the test by entering the following sequence into the LEB DSKY.

a. VERB 57, ENTER
b. 00003, ENTER

6.2.17.11 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data is displayed in R1 and R2 on the DSKY.

a. R1 = +13500
b. R2 = +xx.xxx (Site Latitude from Table I)

Table 1

Test Site	Latitude
NAA	+33.922
KSC	+28.516
MSC	+29.556

6.2.17.12 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If the value displayed is other than +13500 in R1 and the correct Site Latitude in R2, correct the data by entering the following sequence into the DSKY.

a. VERB 21, ENTER
b. +13500, ENTER
c. VERB 22, ENTER
d. +xx.xxx, ENTER (+xx.xxx = Site Latitude from Table I)
e. VERB 33, ENTER

6.2.17.13 Observe VERB 21 NOUN 30 flashing on the DSKY. Enter the following sequence into the DSKY.

a. +00001, ENTER (Position Number)
b. +00000, ENTER
c. +00001, ENTER

6.2.17.14 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

a. R1 = +xxx.xx (Y_{NB} Azimuth)
b. R2 = ±xx.xxx (Y_{NB} Elevation)
c. R3 = 00001

6.2.17.15 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Y_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.

a. VERB 24, ENTER
b. +xxx.xx ± 002.00 degrees, ENTER (Y_{NB} Azimuth)
c. +xx.xxx ± 02.000 degrees, ENTER (Y_{NB} Elevation)
d. VERB 33, ENTER

6.2.17.16 Observe VERB 06 NOUN 66 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

a. R1 = +xxx.xx (Z_{NB} Azimuth)
b. R2 = ±xx.xxx (Z_{NB} Elevation)
c. R3 = 00002

6.2.17.17 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct Z_{NB} azimuth and elevation, correct the data by entering the following sequence into the DSKY.

a. VERB 24, ENTER
b. +xxx.xx ± 002.00 degrees, ENTER (Z_{NB} Azimuth)
c. +xx.xxx ± 02.000 degrees, ENTER (Z_{NB} Elevation)
d. VERB 33, ENTER

6.2.17.18 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

a. R1 = +xxx.xx (Target 1 Azimuth)
b. R2 = ±xx.xxx (Target 1 Elevation)
c. R3 = 00001

6.2.17.19 If the data displayed is correct enter VERB 33 ENTER into the DSKY. If R1 and R2 do not contain the correct azimuth and elevation for Target 1, correct the data by entering the following sequence into the DSKY.

a. VERB 24, ENTER
b. +xxx.xx ± 000.10 degrees, ENTER (Target 1 Azimuth)
c. ±xx.xxx ± 00.010 degrees, ENTER (Target 1 Elevation)
d. VERB 33, ENTER

6.2.17.20 Observe VERB 06 NOUN 61 flashing on the DSKY. The following data shall be displayed in R1, R2 and R3.

a. R1 = +xxx.xx (Target 2 Azimuth)
b. R2 = ±xx.xxx (Target 2 Elevation)
c. R3 = 00002

6.2.17.21 If the data displayed is correct proceed to 6.2.17.22. If R1 and R2 do not contain the correct azimuth and elevation for Target 2, correct the data by entering the following sequence into the DSKY.

a. VERB 24, ENTER
b. +xxx.xx ± 000.10 degrees, ENTER (Target 2 Azimuth)
c. ±xx.xxx ± 00.010 degrees, ENTER (Target 2 Elevation)

6.2.17.22 Set the OPTICS MODE switch to ZERO. After 15 seconds return the switch to MAN. Enter VERB 33, ENTER into the DSKY.

6.2.17.23 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch on the G&N Indicator Control Panel to CMC. The CMC will align the SXT to the Target 1 position. When the alignment is complete as observed by no further movement of the Telescope Panel Angle Counters (TPAC), set the OPTICS MODE switch to MANUAL.

6.2.17.24 Using the Optics Hand Controller, align the SXT StLOS with Target 1 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with MARK press the MARK REJECT pushbutton and repeat this step.

6.2.17.25 When VERB 51 NOUN 30 flashes on the DSKY set the OPTICS MODE switch to CMC. The CMC will align the SXT to the Target 2 position. When alignment is complete as observed by no further movement of the TPAC, set the OPTICS MODE switch to MANUAL.

6.2.17.26 Using the Optics Hand Controller, align the SXT StLOS with Target 2 and press the MARK pushbutton. If satisfied that the MARK was good press the ENTER pushbutton. If not satisfied with the MARK press the MARK REJECT pushbutton and repeat this step.

6.2.17.27 Repeat steps 6.2.17.23 through 6.2.17.26.

6.2.17.28 In approximately 7 minutes VERB 06 NOUN 66 shall flash on the DSKY and the test results shall be displayed. R1 and R2 on the DSKY shall display the misalignment of one of the horizontal PIPA's in arc seconds (R1 = whole, R2 = fractional). Record R1 and R2. (See Table II for PIPA displayed).

6.2.17.29 Enter VERB 33 ENTER into the DSKY. When VERB 06 NOUN 66 flashes R1 and R2 on the DSKY shall display the misalignment of the second horizontal PIPA in arc seconds (R1 whole, R2 fractional). (See Table III for PIPA displayed.) Record R1 and R2.

6.2.17.30 Enter VERB 34 ENTER into the DSKY to terminate the test.

6.2.17.31 Repeat steps 6.2.17.10 through 6.2.17.29 substituting position no. 00002 in 6.2.17.13.a.

6.2.17.32 Enter the following sequence into the DSKY:

a. VERB 36, ENTER
b. VERB 41 NOUN 20, ENTER
c. +00000, ENTER
d. +00000, ENTER
e. +00000, ENTER

6.2.17.33 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OFF.

Table III. Display Conditions at Test Completion

Position	SM Orientation X_{SM}	Y_{SM}	Z_{SM}	6.2.17.28	6.2.17.29
1	UP	SW	SE	Y PIPA about Z PIPA	Z PIPA about Y PIPA
2	SE	SW	DN	X PIPA about Y PIPA	Y PIPA about X PIPA
3*	SE	UP	SW	X PIPA about Z PIPA	Z PIPA about X PIPA

* Position 3 is not run in the Spacecraft because of GIMBAL LOCK considerations.

6.2.17.34 Calculations

6.2.17.34.1 a. Y PIPA about Z misalignment = ( ) R1 . R2
b. Z PIPA about Y misalignment = (( ) R1 . R2
c. X PIPA about Y misalignment = ( ) R1 . R2
d. Y PIPA about X misalignment = ( ) R1 . R2

6.2.17.34.2 Enter the latest values from 6.2.16 IMU Performance Test.

a. X PIPA bias = ________________ cm/sec^2
b. Y PIPA bias = ________________ cm/sec^2
c. Z PIPA bias = ________________ cm/sec^2
d. θ_x = 210 (X PIPA bias) = ____________ arc sec.
e. θ_y = 210 (Y PIPA bias) = ____________ arc sec.
f. θ_z = 210 (Z PIPA bias) = ____________ arc sec.

6.2.17.34.3

a. Y PIPA about Z misalignment (Bias corrected) =
6.2.17.34.1a - θ_y = ________________ arc sec.

b. Z PIPA about Y misalignment (Bias corrected) =
6.2.17.34.1b - θ_z = ________________ arc sec.

c. X PIPA about Y misalignment (Bias corrected) =
6.2.17.34.1c - θ_x = ________________ arc sec.

d. Y PIPA about X misalignment (Bias corrected) =
6.2.17.34.1d - θ_y = ________________ arc sec.

The PIPA misalignments, excluding PIPA bias, shall not exceed ± 150 arc seconds.

6.2.18 Gyrocompassing Test

Note: Proceed with this test if 6.2.3 Operate Power On Test has been completed and system operation has not been interrupted. If system operation has been interrupted, perform 5.2.5.2, Turn On Procedure.

BUS

6.2.18.1 Set the G/N POWER-OPTICS switch on the LEB Lighting Control Panel to OPTICS. Verify that _28 vdc OPTICS OPERATE BUS (CG 1530) is +28.0 ± 3.0 vdc. Verify that OPTX 28V 800 cps 1% 0° (CG 1211) and OPTX 28V 800 cps 5% - 90° (CG 1212) are not flashing on the CRT.

6.2.18.2 Obtain the most recent values for NBD, ADSRA, and ADIA. Load this data into the CMC using the following sequence:

VERB 21 NOUN 01, ENTER
1432, ENTER
NBDX, ENTER
1433, ENTER
NBDY, ENTER
1434, ENTER
NBDZ, ENTER
1435, ENTER
ADIAX, ENTER
1436, ENTER
ADIAY, ENTER
1437, ENTER
ADIAZ, ENTER
1440, ENTER
ADSRAX, ENTER
1441, ENTER
ADSRAY, ENTER
1442, ENTER
ADSRAZ, ENTER

6.2.18.3 If the gyrocompass azimuth will require that the Stable Member be aligned to a non-standard position, it will be necessary to load the correct orientation matrix into the CMC. This matrix loaded into PRELMTRX through PRELMTRX + 17D.

6.2.18.4 Enter the following into the DSKY:

a. VERB01 NOUN 01, ENTER
b. 00362, ENTER

Record R1 = XXXXY

6.2.18.5 Enter the following into the DSKY:

a. VERB 01 NOUN 01, ENTER
b. 00362, ENTER
c. XXXXY^{1}, ENTER where Y' is determined by Table I and XXXX is that recorded in 6.2.18.4.

TABLE I

Y (From 6.2.18.4)	0	1	2	3	4	5	6	7
Y'	2	3	2	3	6	7	6	7

6.2.18.6 Enter the following into the DSKY:

a. VERB 57, ENTER
b. 00007, ENTER

6.2.18.7 Observe the following on the DSKY.

a. VERB 06 NOUN 61 flashing
b. R1 - ± XXX.XX (Some Z NB azimuth)
c. R2 = ∓ XX.XXX (Some Test Site Latitude)

If the displays are correct, proceed to step 6.2.18. If not perform 6.2.18.8

6.2.18.8 Enter the following into the DSKY:

a. To change R1 enter VERB 21, ENTER ± XXX.XX, ENTER where ± XXX.XX is the correct Z NB azimuth
b. To change R2 enter VERB 22, ENTER; + XX.XXX, ENTER where + XX.XXX is the correct Site Latitude from Table II.

TABLE II

Location	Latitude
NAA	33.917
KSC	28.516
MSC	29.556

6.2.18.9 Enter VERB 33, ENTER into the DSKY

6.2.18.10 Observe the following displayed on the DSKY

a. VERB 06 NOUN 66 flashing
b. R1 = XXXXX (1/5 vertical erect time in sec)
c. R3 = XXXXX (Position No.)

R1 should contain + 00120 and R3 should contain + 00011. If the data displayed is correct, proceed to step 6.2.18.12, if not performed 6.2.18.11.

6.2.18.11 Enter the following into the DSKY:

a. To change R1 enter VERB 21, ENTER; + 00120, ENTER
b. To change R3 enter VERB 23, ENTER; + 00011, ENTER

6.2.18.12 Enter VERB 33, ENTER into the DSKY. On the DSKY observe the PROGRAM display change to 05 after approximately 90 seconds. Approximately 5 minutes later observe the PROGRAM display change to 02.

6.2.18.13 After 120 minutes set the OPTICS MODE switch on the G&N Indicator Control Panel to Zero. Wait 15 seconds and return the OPTICS MODE switch to MAN.

6.2.18.14 Enter VERB 52, ENTER into the DSKY. Observe the PROGRAM display on the DSKY change to 03.

6.2.18.15 When VERB 06 NOUN 61 flashed on the DSKY, insure that R1 and R2 display Target 1 azimuth and elevation.

a. R1 = + XXX.XX (Target 1 azimuth)
b. R2 = + XX.XXX (Target 1 elevation)

6.2.18.16 Verify the data appearing in R1 and R2 and if correct, proceed. If not correct, perform the following sequence:

a. VERB 24, ENTER
b. + XXX.XX, ENTER (Target 1 azimuth)
c. ± XX.XXX, ENTER (Target 1 elevation)

6.2.18.17 After the correct readings for R1 and R2 are verified, enter VERB 33, ENTER into the DSKY.

6.2.18.18 When VERB 06 NOUN 61 flashes on the DSKY, insure that R1 and R2 display Target 2 azimuth and elevation.

a. R1 = XXX.XX (Target 2 azimuth)
b. R2 = XX.XXX (Target 2 elevation)

6.2.18.19 Verify the data appearing in R1 and R2 and if correct, perform the following sequence.

a. VERB 24, ENTER
b. +XXX.XX, ENTER (Target 2 azimuth)
c. ± XX.XXX, ENTER (Target 2 elevation)

6.2.18.20 After the correct readings for R1 and R2 are verified enter enter VERB 33, ENTER into the DSKY.

6.2.18.21 On the G&N Indicator Control Panel set the CONTROLLER SPEED TO Hi. Using the Optics Hand Controller, drive the SXT ST LOS to the approximate position of Target 1.

6.2.18.22 Set the CONTROLLER SPEED switch on the G&N Indicator Control Panel to LO. Using the Optics Hand Controller, align the SXT STLOS to target 1 and press MARK pushbutton. If not satisfied with MARK, Press the MARK REJECT pushbutton and repeat this step.

6.2.18.23 Set the CONTROLLER SPEED switch to HI. Using the Optics Hand Controller, drive the SXT STLOS to the approximate position of Target 2.

6.2.18.24 Set the CONTROLLER SPEED switch to LO. Using the Optics Hand Controller, align the SXT STLOS to Target 2 and press the MARK pushbutton. If satisfied that the MARK was good, press the ENTER pushbutton. If not satisfied, press the MARK REJECT pushbutton and repeat this step.

6.2.18.25 On the DSKY observe the following data displayed:

a. VERB 06 NOUN 60
b. R1 = ± XX.XXX (X gyro elevation error, deg.)
c. R2 = ±XX.XXX(Y gyro elevation error, deg.)
d. R3 = ± XX.XXX (Z gyro elevation error, deg.)

Record R1, R2 and R3.

6.2.18.26 Enter VERB 34, ENTER into the DSKY. Observe the PROGRAM display change to 02.

6.2.18.27 Repeat steps 6.2.18.14 through 6.2.18.26 for the next hour at the following intervals:

a. 15 min.
b. 30 min.
c. 45 min.
d. 60 min.

6.2.19 **CMC Voltage Margin Test**

6.2.19.1 Verify that the G&N IMU HTR MNA & MNB circuit breakers are engaged, Computer MNA & MNB breakers are engaged, IMU MNA & MNB circuit breakers are not engaged, and the G&N Power - IMU switch on the LEB Lighting Control Panel is in the OFF position.

6.2.19.2 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON.

Caution: During the performance of this test the +4 VDC CMC Power Supply shall not be operated at less than +2.5 VDC or greater than 5.2 VDC (CG 1030). The +14 VDC CMC Power Supply shall not be operated at less than +8.5 VDC or greater than +17.0 VDC (CG 1020).

Note: The flashing indication of the CMC Power Supplies on CRT may be disregarded for this test. The charts in Table I may be used to determine approximate values for the "XX.X" values of C-156 voltage dial settings corresponding to various power supply voltages.

6.2.19.3 Into Units R-154 insert 0111. Verify and execute.

6.2.19.4 Insert in C-156 ± XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC Power Supply (CG 1020) to 12.1 (+0.3, -0.0) VDC. Execute. Verify CG 1020 on the CRT.

6.2.19.5 Insert in C-156 ± XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC Power Supply (CG 1030) to 3.5 (+0.15, -0.0) VDC. Execute. Verify CG 1030 on the CRT.

6.2.19.6 On K-148 press ERROR RESET

6.2.19.7 Initiate CMC Self-Check by inserting the following into K-148.

a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER

Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

6.2.19.8 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on DSKY is lighted.

6.2.19.9 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148:

a. VERB 21, NOUN 27, ENTER
b. 77777, ENTER

6.2.19.10 Insert into C-156 ± XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC. Power Supply (CG 1020) to +16.4 (0.0, -0.4) VDC. Execute. Verify CG 1020 on the CRT.

6.2.19.11 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on DSKY is not lighted.

6.2.19.12 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to off. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to ON. Press ERROR RESET. Insert into K-148.

a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER

6.2.19.13 Insert into C-156 ± XX.X001234 (Enter a value for XX.X which will adjust the +4 VDC CMC Power Supply (CG 1030) to 4.5 (+0.0, -0.2)VDC. Execute. Verify CG 1030 on the CRT.

6.2.19.14 Press ERROR RESET on k-148. Wait 200 Seconds. Verify RESTART lamp on DSKY is not lighted.

6.2.19.15 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted. Set the INHIBIT VOLTAGE FAIL switch to on. Press ERROR RESET. Insert into K-148.

a. VERB 21 NOUN 27, ENTER
b. 77777, ENTER

6.2.19.16 Insert into C-156 ± XX.X001244 (Enter a value for XX.X which will adjust the +14 VDC CMC Power Supply (CG 1020) to 12.1 (+0.3, -0.0) VDC. Execute. Verify CG 1020 on the CRT.

6.2.19.17 Press ERROR RESET on K-148. Wait 200 seconds. Verify RESTART lamp on the DSKY is not lighted.

6.2.19.18 On the PSA Adapter Module set the INHIBIT VOLTAGE FAIL switch to OFF. Verify RESTART lamp on the DSKY is lighted.

6.2.19.19 Into R-154 insert 0000. Verify and execute.

6.2.19.20 Terminate the CMC Self-Check by inserting into K-148:

a. VERB 21 NOUN 27, ENTER
b. 00000, ENTER

Press ERROR RESET on K-148.

NUMBER	REVISION LETTER	PAGE

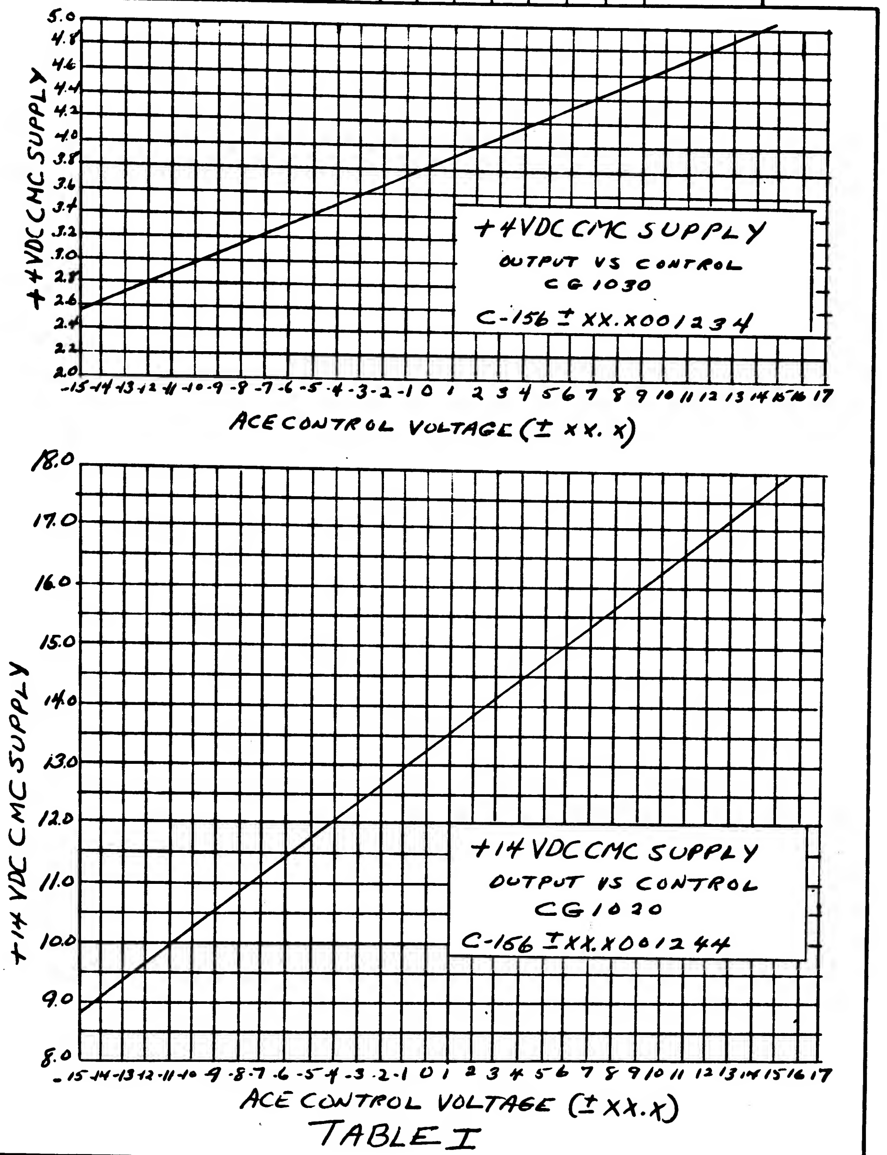

TABLE I

6.2.21 **Spacecraft Control and Displays Test.**

6.2.21.1 **Proceed with this test if the Operate Power On Test of 6.2.3 and system operation has not been interrupted. If system operation has been interrupted, perform 6.2.5.2 before proceeding.**

6.2.21.2 **FDAI Attitude Error.**

6.2.21.2.1 Insert in K148

a. V57 ENTER
b. 00013 ENTER

6.2.21.2.2 Observe on CRT

a. V06 N01 Flashing
b. PROG 07
c. NO ATT ON
d. R1, R2, and R3 Approx. 00000

6.2.21.2.3 Insert in K148

a. VERB 33, ENTER

6.2.21.2.4 Observe on CRT

a. V06 R1 Flashing
b. R1 +00385
c. R2 -00385
d. R3 +00385
e. NO ATT OFF

6.2.21.2.5 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees

6.2.21.2.6 Insert in K148

a. VERB 33, ENTER

6.2.21.2.7 Observe on CRT

a. V06 N01 Flashing
b. R1 +00384
c. R2 -00384
d. R3 +00384

6.2.21.2.8 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+16.88 ± 1.65 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-16.88 ± 1.65 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+16.88 ± 1.65 degrees

6.2.21.2.9 Insert in K148

a. VERB 33, ENTER

6.2.21.2.10 Observe on CRT

a.	V06	N01	Flashing
b.	R1		+00160
c.	R2		-00160
d.	R3		+00160

6.2.21.2.11 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+6.95 ± 0.69 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-6.95 ± 0.69 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+6.95 ± 0.69 degrees

6.2.21.2.12 Insert in K148

a. VERB 33, ENTER

6.2.21.2.13 Observe on CRT

a.	V06	N01	Flashing
b.	R1		+00135
c.	R2		-00135
d.	R3		+00135

6.2.21.2.14 Record CRT indications

a.	CG 2279	ROLL ATT ERROR - CDU DAC OUT	+5.88 ± 0.59 degrees
b.	CG 2219	PITCH ATT ERROR - CDU DAC OUT	-5.88 ± 0.59 degrees
c.	CG 2249	YAW ATT ERROR - CDU DAC OUT	+5.88 ± 0.59 degrees

6.2.21.2.15 Insert in K148

a. VERB 33, ENTER

6.2.21.2.16 Observe on CRT

a.	V06	N01	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00090

6.2.21.2.17 Record CRT indications.

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT +3.93 ± 0.39 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT -3.93 ± 0.39 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT +3.93 ± 0.39 degrees

6.2.21.2.18 Insert in K148

a. VERB 33, ENTER

6.2.21.2.19 Observe on CRT

a. V06 N01 Flashing
b. R1 +00000
c. R2 +00000
d. R3 -00090

6.2.21.2.20 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT 0.00 ± 0.19 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT 0.00 ± 0.19 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT -3.93 ± 0.39 degrees

6.2.21.2.21 Insert in K148

a. VERB 33, ENTER

6.2.21.2.22 Observe on CRT

a. V06 N01 Flashing
b. R1 -00090
c. R2 +00090
d. R3 -00135

6.2.21.2.23 Record CRT indications

a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -3.93 ± 0.39 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +3.93 ± 0.39 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT -5.88 ± 0.59 degrees

6.2.21.2.24 Insert in K148

a. VERB 33, ENTER

6.2.21.2.25 Observe on CRT

a. V06 N01 Flashing
b. R1 -00135
c. R2 +00135
d. R3 -00160

6.2.21.2.26 Record CRT indications
a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -5.88 ± 0.59 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +5.88 ± 0.59 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT -6.95 ± 0.69 degrees

6.2.21.2.27 Insert in K148
a. VERB 33, ENTER

6.2.21.2.28 Observe on CRT
a. V06 N01 Flashing
b. R1 -00160
c. R2 +00160
d. R3 -00384

6.2.21.2.29 Record CRT indications
a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -6.95 ± 0.69 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +6.95 ± 0.69 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees

6.2.21.2.30 Insert K148
a. VERB 33, ENTER

6.2.21.2.31 Observe on CRT
a. V06 N01 Flashing
b. R1 -00384
c. R2 +00384
d. R3 -00385

6.2.21.2.32 Record CRT indications
a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
c. CG 2249 YAW ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees

6 2.21.2.33 Insert in K148
a. VERB 33, ENTER

6.2.21.2.34 Observe on CRT
a. V06 N01 Flashing
b. R1 -00385
c. R2 +00385
d. R3 +00000

6.2.21.2.35 Record CRT indications

- a. CG 2279 ROLL ATT ERROR - CDU DAC OUT -16.88 ± 1.65 degrees
- b. CG 2219 PITCH ATT ERROR - CDU DAC OUT +16.88 ± 1.65 degrees
- c. CG 2249 YAW ATT ERROR - CDU DAC OUT 0.00 ± 0.19 degrees

6.2.21.2.36 Insert in K148

- a. V21 N01 ENTER
- b. 02545 ENTER
- c. 03302 ENTER
- d. V33 ENTER

6.2.21.2.37 Observe on CRT

- a. V06 N03 Flashing
- b. NO ATT ON
- c. R1 +00000 approximately
- d. R2 +00000 approximately
- e. R3 +00000 approximately

6.2.21.3 TVC Test

6.2.21.3.1 The G/N Autopilot Control and SPS Ready discretes shall be applied to the G/N Interface.

6.2.21.3.2 Set the OPTICS MODE selector on the Indicator Control Panel to MAN.

6.2.21.3.3 Insert in K148

a. VERB 33, ENTER

6.2.21.3.4 Observe on CRT

a. V 01 N10 Flashing
b. R1 X7373
c. R3 00030

6.2.21.3.5 Insert in K148

a. V 33 ENTER

6.2.21.3.6 Observe on CRT

a. V 01 Noun 10 Flashing
b. R1 37777
c. R3 00031

6.2.21.3.7 Insert in K148

a. V 33 ENTER

6.2.21.3.8 Observe on CRT

a. V06 N03 Flashing
b. R1 +00385
c. R2 -00385
d. R3 +00003

6.2.21.3.9 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +16.88 ± 1.00 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT -16.88 ± 1.00 degrees

6.2.21.3.10 Insert in K148

a. VERB 33, ENTER

6.2.21.3.11 Observe on CRT

a. V06 N 03 Flashing
b. R1 +00384
c. R2 -00384
d. R3 +00003
e. NO ATT OFF

6.2.21.3.12 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +16.88 ± 1.00 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT -16.88 ± 1.00 degrees

6.2.21.3.13 Insert in K148

a. VERB 33, ENTER

6.2.21.3.14 Observe on CRT

a. V06 N 03 Flashing
b. R1 +00160
c. R2 -00160
d. R3 +00003

6.2.21.3.15 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +6.95 ± 0.41 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT -6.95 ± 0.41 degrees

6.2.21.3.16 Insert in K148

a. VERB 33 ENTER

6.2.21.3.17 Observe on CRT

a. V06 N 03 Flashing
b. R1 +00135
c. R2 -00135
d. R3 +00003

6.2.21.3.18 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT +5.88 ± 0.35 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT -5.88 ± 0.35 degrees

6.2.21.3.19 Insert in K148

a. VERB 33 ENTER

6.2.21.3.20 Observe on CRT

a.	V06	N 03	Flashing
b.	R1		+00090
c.	R2		-00090
d.	R3		+00003

6.2.21.3.21 Record CRT indications

a.	CG 3722	TRUNNION CDU DAC OUTPUT	+3.93 ± 0.24 degrees
b.	CG 3721	SHAFT CDU DAC OUTPUT	-3.93 ± 0.24 degrees

6.2.21.3.22 Set the OPTICS CONTROLLER SPEED Switch on the Indicator Control panel to HI.

6.2.21.2.23 Insert in K148

a. VERB 33 ENTER

6.2.21.3.24 Observe on CRT

a.	V06	N 03	Flashing
b.	R1		+00000
c.	R2		+00000
d.	R3		+00003

6.2.21.3.25 While holding the Optics Hand Controller up and left (45°) no longer than 10 seconds, record CRT indications.

a.	CG 3722	TRUNNION CDU DAC OUTPUT	0.00 ± 0.19 degrees
b.	CG 3721	SHAFT CDU DAC OUTPUT	0.00 ± 0.19 degrees

6.2.21.3.26 Insert in K148

a. VERB 33 ENTER

6.2.21.3.27 Observe on CRT

a.	V06	N 03	Flashing
b.	R1		-00090
d.	R2		+00090
d.	R3		+00003

6.2.21.3.28 Record CRT indidations

a.	CG 3722	TRUNNION CDU DAC OUTPUT	-3.93 ± .24 degrees
b.	CG 3721	SHAFT CDU DAC OUTPUT	+3.93 ± .24 degrees

6.2.21.3.29 Set the OPTICS MODE Switch on the Indicator Control Panel to ZERO for 30 seconds, then return to MAN.

6.2.21.3.30 Insert in K148

a. VERB 33 ENTER

6.2.21.3.31 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00135
c. R2 +00135
d. R3 +00003

6.2.21.3.32 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -5.88 ± 0.35 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +5.88 ± 0.35 degrees

6.2.21.3.33 Insert in K148

a. VERB 33 ENTER

6.2.21.3.34 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00160
c. R2 +00160
d. R3 +00003

6.2.21.3.35 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -6.95 ± 0.41 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +6.95 ± 0.41 degrees

6.2.21.3.36 Insert in K148

a. VERB 33 ENTER

6.2.21.3.37 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00384
c. R2 +00384
d. R3 +00003

6.2.21.3.38 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -16.88 ± 1.00 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +16.88 ± 1.00 degrees

6.2.21.3.39 Insert in K148

a. VERB 33 ENTER

6.2.21.3.40 Observe on CRT

a. V06 N 03 Flashing
b. R1 -00385
c. R2 +00385
d. R3 +00003

6.2.21.3.41 Record CRT indications

a. CG 3722 TRUNNION CDU DAC OUTPUT -16.88 ± 1.00 degrees
b. CG 3721 SHAFT CDU DAC OUTPUT +16.88 ± 1.00 degrees

6.2.21.3.42 Insert in K148

a. V 34 ENTER
b. V 40 N 20 ENTER
c. V 41 N 20 ENTER
d. +00000 ENTER
e. +00000 ENTER
f. +00000 ENTER

APPENDIX I

Signal	Nomenclature	G&N Test Requirement	PSAAM and/or SCA Uncertainty % of Full Scale
CG 1020	+14 VDC CMC SUPPLY	+14.0 ± 0.4 VDC	0%
CG 1030	+4 VDC CMC SUPPLY	+4.00 ± 0.2 VDC	0%
CG 1040	-120 VDC PIPA SUPPLY	+120 ± 6.0 VDC	1%
CG 1051	+20 VDC PIPA SUPPLY	+20.0 ± 1.2 VDC	0%
CG 1052	-20 VDC PIPA SUPPLY	-20 ± 2 VDC	0%
CG 1070	+4 VDC CDU SUPPLY	+4.0 ± 0.2 VDC	0%
CG 1100	-28 VDC SUPPLY	-27.5 ± 6.0 VDC	0%
CG 1110	2.5 VDC TM BIAS	+2.50 ± 0.05 VDC	0%
CG 1201	IMU 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1%
CG 1202	IMU 28V .8KC 5% - 90° RMS	28.0 ± 1.4 VRMS	1.5%
CG 1203	IMU 28V .8KC 0°RMS	28.0 ± 2.1 VRMS	1.5%
CG 1207	PH DIFF IMU 5% 0°, -90°	90 ± 10°	3%
CG 1211	OPTX 28V .8KC 1% 0° RMS	28.00 ± 0.56 VRMS	1.5%
CG 1212	OPTX 28V .8KC 5% - 90° RMS	28.00 ± 1.48 VRMS	1.5%
CG 1220	PH DIFF OPTX 1% IMU 1%	0° ± 10°	3%
CG 1331	3.2 KC 28V SUPPLY	28.6 ± 0.56 VRMS	1%
CG 1336	PH DIFF 3.2 KC 28V/CMC SYNC	0° ± 10°	3%
CG 1500	+28 VDC IMU OPERATE BUS	28.8 ± 3 VDC	0%
CG 1510	+28 VDC IMU STANDBY BUS	28.8 ± 3 VDC	0%
CG 1520	+28 VDC CMC OPERATE BUS	28.8 ± 3 VDC	0%
CG 1530	+28 VDC OPTX OPERATE BUS	28.8 ± 3 VDC	0%
CG 2001	X PIPA SG O/P	5 VRMS max	3%
CG 2021	Y PIPA SG O/P	5 VRMS max	3%
CG 2041	Z PIPA SG O/P	5 VRMS max	3%
CG 2108	IG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2112	IG 1X RESOLVER O/P SIN	(18.38 ± 1.84) 19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2113	IG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2117	IG SERVO ERROR IN PHASE	0.0 ± 60mv RMS @ null	2%
CG 2120	IG TORQUE MOTOR CURRENT	0.125 amp max during Fine Alignment Torquing	2%
CG 2138	MG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2142	MG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2143	MG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2147	MG SERVO ERROR IN PHASE	0.0 ± 60 mv rms @ null	2%
CG 2150	MG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%
CG 2168	OG SERVO ERROR QUAD	0.0 ± 1.2 VRMS	3%
CG 2172	OG 1X RESOLVER O/P SIN	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2173	OG 1X RESOLVER O/P COS	19.65 ± 0.98 VRMS @ 45°	2.5%
CG 2177	OG SERVO ERROR IN PHASE	0.0 ± 60 mv RMS @ null	2%
CG 2180	OG TORQUE MOTOR CURRENT	0.125 amp max during Fine Align Torquing	2%

Signal	Nomenclature	G&N Test Requirements	PSAAM and/or SCA Uncertainty % of Full Scale
CG 2219	PITCH ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2220	IG CDU FINE ERROR	0.0 ± 0.7 VRMS @ null	1%
CG 2221	IG CDU COARSE ERROR	0.0 ± 0.68 VRMS @ null	1%
CG 2249	YAW ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2250	MG CDU FINE ERROR	0.0 ± 0.7 VRMS @ null	1%
CG 2251	MG CDU COARSE ERROR	0.0 ± 0.68 VRMS @ null	1%
CG 2279	ROLL ATT ERROR-CDU DAC O/P	5.06 ± 0.5 VRMS @ 17°	2%
CG 2280	OG CDU FINE ERROR	0.0 ± 0.07 VRMS 2 null	1%
CG 2281	OG CDU COARSE ERROR	0.0 ± 0.68 VRMS	1%
CG 2300	PIPA TEMPERATURE	130 ± 1.5°F Operate Mode	0%
CG 3011	TRUNNION CDU FINE ERROR	0.0 ± 0.07 VRMS @ null	1%
CG 3021	SHAFT CDU FINE ERROR	0.0 ± 0.07 VRMS @ null	1%
CG 3117	SXT SHAFT SERVO ERROR IN PH	2 VRMS max	2%
CG 3118	SXT TRUNNION SERVC ERROR IN PHASE	2 VRMS max	2%
CG 3140	SXT SHAFT TACH O/P	3.1 ± 1.1 VRMS @Hi Rate	2%
CG 3145	SXT SHAFT MTR CONTROL WINDING	3.3 ± 1.3 VRMS @Hi Rate	2%
CG 3150	SXT TRUNNION TACH O/P	3.3 ± 1.3VRMS @ Hi Rate	2%
CG 3155	SXT TRUNNION MTR CONTROL WINDING	0.85 ± 0.35 VRMS at Hi Rate	2%
CG 3160	SCT SHAFT TACH O/P	3.3 ± 1.3 VRMS @ Hi Rate	2%
CG 3170	SCT TRUNNION TACH O/P	0.85 ± 0.35VRMS @Hi Rate	2%
CG 3721	SHAFT CDU DAC O/P	5.06 ± 0.50VRMS @17°	1%
CG 3722	TRUNNION CDU DAC O/P	5.06 ± 0.50 VRMS @17°	1%
CG 4300	CMC TEMP	87.5 ± 42.5°F	0%
YG 6020	PIPA CAL MODULE TEMP	72.5 ± 27.5°F	0%
CG 6021	IMU 800 cps 5% TEMP (PSA)	90 ± 30°F	0%
CG 2301	IRIG TEMPERATURE	135 ± 2.5°F in Operate	0%

All uncertainties specified above and those due to instrumentation in the ACE equipment shall be root sum squared with the basic system tolerances to yield an acceptable tolerance for use when testing the G&N System in the spacecraft.